



Johnson Space Center  
Procedural  
Requirements

JPR No.:	1700.1J
Effective Date:	April 16, 2008
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Change 2	8/29/11

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Compliance is Mandatory

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## **JSC SAFETY AND HEALTH HANDBOOK**

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**Responsible Office: Safety and Mission Assurance Office**

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<http://jschandbook.jsc.nasa.gov/RevJ/default.htm>

JSC Form JF2420B (MS Word August 28, 2006) (Revised May 30, 2007)

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**Change Record for JPR 1700.1, “JSC for Safety and Health Handbook”  
(Baseline – Revision G)**

<i>Change . .</i>	<i>Date . . .</i>	<i>Originator...</i>	<i>Chapters affected . .</i>	<i>Description of change . . .</i>
Change 1 to Rev G	11/14/97	D. L. Clem, extention 34272	106 203 505	Adds process for reporting international mishaps Removes requirement for bicycle helmets Updates lifting requirements
Editorial	7/10/98	D. L. Clem, extention 34272	Preface	Revises JSC Safety Policy per ESC direction
Change 2 to Rev G	8/6/98	D. L. Clem, extention 34272	114	Updates safety committee structure Changes time to serve on committees and allows for volunteer members
Revision H	2/3/99	D. L. Clem, extention 34272	Entire Document	Includes upgrades from comparing JPG 1700.1 with NASA requirements Includes upgrades from comparing JPG 1700.1 with 29 CFR 1960 requirements Includes upgrades from comparing JPG 1700.1 with VPP and PEP requirements Includes other changes suggested by various JSC organizations
Change 1 to Rev H  (Editorial Included in hard copies)	3/99	D. L. Clem, extention 34272	100 101 108 309	Update URL to on- line version and paragraph 5 Include JSC Safety Policy and rearrange chapter Update cross references Clarify “enough time” to “3 - 5 days before TRR”
Editorial	7/2000	D. L. Clem, extention 34272	Subject Index	Changed “Job Safety Analysis” to “Job Hazard Analysis” to be consistent with Chapter 111.
Revision I	7/2002	D. L. Clem, extention 34272	Entire document	Reorganizes program requirements around VPP elements. New Lockout/Tagout and Chemical alarm chapters. Updates to other chapters.

Change 1 to Rev I	11/7/02	D. L. Clem, extention 34272	3.6	Changes to medical exam requirements.
			5.1	Clarifies storage requirements.
			5.2	Clarifies requirements for space heaters
			6.8	New safe work practices and design requirements.
			7.3	Added responsibility for radiation equipment.
			Glossary	Changed Oxygen Enriched Atmosphere definition.
			2.7, 6.8, 6.10, 8.1, 9.3, and Attachment 3.6A – Appendix 3B	Clarifies emergency number for the Sonny Carter Training Facility.
Change 2 to Rev I	5/11/04	D. L. Clem, extention 34272	5.7	Changes to accommodate new Part 12
			Part 12	Adds new Asbestos Control Requirements. This is a revision of the Asbestos Control Manual
Change 3 to Rev I	6/2/05	D. L. Clem, extention 34272	Document number	Changed number to JPR 1700.1
			5.9	New chapter on Weather Safety
			6.1	Updates emergency eyewash & shower reqmts
			6.5	Updates emergency eyewash & shower reqmts
			6.8	Updates emergency eyewash & shower reqmts
			6.13	New chapter on breathing gases
			8.5 & Appendix 5B	Adds inspection program for forklifts & slings, eliminates duplicate requirements
			8.6	Adds inspection program for power tools
			8.7	Adds inspection program for ladders
			9.1	Updates several hazardous material requirements
			9.2	Updates several hazardous material requirements
			10.1	Updates emergency eyewash & shower reqmts
			12.1 and Part 12	Clarifies applicability to JSC field sites
				Removes advisory language and updates organizational titles & document numbers in several other chapters

Change 4 to Rev I	9/25/06	D. L. Clem, extention 34272	2.4	Adds reference to NASA Facility System Safety Guidebook.
			2.7	Updates mishap investigation products to reference NASA mishap reporting and investigation requirements.
			5.2	Adds requirement not to wear jewelry during maintenance or troubleshooting on any electrical or mechanical system.
			6.1	Revises processes for handling and disposing of batteries.
			6.4	Revises food safety requirements.
			6.11	Adds a requirement to test oxygen and oxygen enriched gas systems with oxygen or oxygen-enriched gas before introducing a human into the loop.
			6.13	Adds requirement to allow the Safety and Test Operations Division to waive cleanliness requirements.
			10.1	Adds construction safety requirements as a result of a mishap investigation and updates requirements for construction barriers.
			10.3	Adds provisions for a less-rigorous Use Readiness Review.
			11.2	Adds requirements for construction contracts as a result of a mishap investigation.
			Glossary	Updates the definition of “oxygen enriched” consistent with the changes to Chapter 6.11.
			Several	Updates title of the Occupational Health Branch

Change 5 to Rev I	1/12/07	D. L. Clem, extention 34272	8.2 Appendix 8B	Temporary change via JSC Announcement to update Lockout/Tagout requirements pending a complete revision of JPR 1700.1. Also deletes Attachment 8.2A and revises Attachment 8.2B of Appendix 8B.
Revision J	4/16/08	D. L. Clem, extention 34272	Entire Document	Complete revision to several chapters.
Change 1 to Rev J	06/10	D. L. Clem, extention 34272	Chapter 5.6  Chapter 6.2  Chapter 6.6  Chapter 6.11	Update process for getting prescription safety glasses.  Updates to laser safety consistent with higher level requirements.  Make physical exam requirements consistent with chapter 3.6.  Update to gas cylinder requirements.

Change 2 to Rev J	<del>xx6</del> 9//11	D. L. Clem, extention 34272	Chapter 1.4	Change process for waivers and changing the handbook to be consistent with revised higher-level requirements.
			Chapter 2.4	Revised list of required hazard analyses. Added clarification on verification methods. Clarified JHA content. Added list of approvals for hazard analyses. Clarified RAC criteria.
			Chapter 2.5	Added reference to NPR 8705.6 for Headquarters audits.
			Chapter 2.7	Added requirement to notify Headquarters of injury reports to OSHA, per NPR 8621.1. Made mishap levels consistent w/NPR 8621.1.
			Attachment 2.7D	Mishap levels consistent w/NPR 8621.1
			Chapter 5.2	Added clarification to ensure feet are clear of floor obstacles and to contact Logistics for help with furniture.
			Chapter 5.8	Updates to be consistent with NPR 8715.3. Includes hard requirement for written tests, adding SCBA certification, clarification of training for category III jobs, and clarification of work shift limitations.
			Chapter 5.10	New chapter describing JSC Automatic External Defibrillator program.
			Chapter 6.5	Removed requirement for eyewash & shower for cryogenic areas.
			Chapter 6.6	Assigned responsibility for annual audits to the Safety & Test Operations Division. Changed Med Ops Branch to Space Medicine Division, removed redundant requirements.
			Chapter 6.9	Clarified requirements for operating procedures. Clarified that tests may proceed after TRR action item are complete. Revised time frame for submitting test documentation to Safety. Clarified mishap reporting requirements. Removed requirements for safety to sign detailed test procedures and to monitor physiological training. Added requirement for biosafety. Added reference to paragraph 1.14.2.b of NPR 8715.3 for offsite tests. Updated organizational titles and document numbers.

Change 2 to Rev J (cont.)	<del>xx6</del> 9//11	D. L. Clem, extention 34272	Chapter 6.10	Added requirements for controlled areas. Clarified def of JSC space. Added other clarifications.
			Chapter 6.11	Added clarification for commercial off-the-shelf flex hoses. Added clarification to requirements for gas cylinders.
			Appendix 6A	Added JSC Form 1023.
			Chapter 8.2	Clarified LO/TO exception for plug and cord electrical equipment.
			Chapter 8.5	Removed reference to JPD 8719.1.
			Chapter 8.6	Added requirement for training in the manufacturer's instructions.
			Chapter 8.7	Added clarification that fall protection is not required for small jobs from ladders.
			Chapter 9.1	Added URL for JSC list of restricted and prohibited chemicals.
			Attachment 9.1A	Deleted due to on-line list.
			Chapter 9.5	Updated document references.
			Chapter 10.3	Clarified coverage of URRs and ORIs. Added flowchart for criteria on URRs and ORIs. Added other clarifications.
			Chapter 10.4	Added clarification that Center-wide data is an acceptable means of maintaining facility baseline documentation, provided access methods are included in general operating procedures. Moved list in Attachment 10.4A to web page.
			Chapter 12.5	Clarified protective clothing for asbestos work.
			Chapter 12.7	Clarified definition of and added qualifications for a "competent person."
			Chapter 12.9	Added requirements for negative pressure enclosures.
			Chapter 12.15	Reclassified some spot removal of asbestos. Added requirements for removing plaster or sheetrock ceilings below ceiling plenum
			Attachments 12A, 12B, 12D, 12E	Updated to be consistent with requirements changes in asbestos chapters.
			Glossary	Replaced "Variance" with "Waiver." Added definition of Test Equipment," Revised mishap levels to be consistent with NPR 8621.1.



## JSC Directives System Procedural Requirements

### Preface

Title: JSC Safety and Health Handbook

#### P1. Purpose

This document defines JSC's Safety and Health Program and provides basic safety and health requirements for the Johnson Space Center (JSC) and for other locations under JSC's jurisdiction. It is important that you follow the safety and health requirements that apply to your job.

#### P2. Applicability

This handbook applies to anyone at JSC or JSC field sites, unless exempted in a specific chapter. For this handbook, "JSC" includes all JSC sites in the Houston area such as Ellington Field and the Sonny Carter Training Facility. The handbook applies to operations involving JSC personnel or equipment at non-JSC locations, including foreign countries. See Chapter 1.4, paragraph 6, for more information on following standards at non-JSC locations.

a. The following table tells you who must follow this handbook.

<i><b>If you . . .</b></i>	<i><b>Then you shall follow . . .</b></i>
Are a federal employee	This handbook unless you work at a site that involves unique military equipment and operations
Are a JSC contractor	This handbook as called out in your contract. Prime contractors must flow down these requirements to subcontractors
Work at a JSC remote site (such as White Sands Test Facility) as a civil service employee or contractor employee	All chapters that don't exempt you and local requirements that meet the intent of any chapter that exempts you  If a chapter exempts you, develop your own requirements that meet the intent of that chapter  The local Quality Assurance, Reliability, and Safety Office or equivalent carries out the responsibilities of the Safety and Test Operations Division at your site
Are a non-NASA or non-contract employee	This handbook while you are on JSC property

b. If you are a federal employee working in a private employer's facility, you are covered by the JSC safety and health program. Although NASA may not have the authority to correct hazardous conditions in a private sector workplace, NASA makes sure your working conditions are safe and healthful. NASA does this by administrative controls or personal protective equipment, or your withdrawal from the private employer's facility.

- c. If you are a private employer, neither Executive Order 12196, "Occupational Safety and Health Programs for Federal Employees," nor this handbook relieves you or your employees of any rights or responsibilities under the Occupational Safety and Health Administration (OSHA).

**P3. Authority**

- a. NPD 8710.2, "NASA Safety and Health Program Policy"
- b. NPR 8715.1, "NASA Occupational Safety and Health Programs"
- c. NPR 8715.3, "NASA General Safety Program Requirements"
- d. Executive Order 12196, dated February 26, 1980, "Occupational Safety and Health Programs for Federal Employees," (3 CFR 1980 Compilation)
- e. 29 Code of Federal Regulations, Part 1960, "Basic Program Elements for Federal Employee Occupational Safety and Health Programs and Related Matters"

**P4. References**

- a. OSHA Instruction TED 8.4, "Voluntary Protection Programs (VPP) Policies and Procedures Manual"
- b. 29 Code of Federal Regulations, Part 1910, "Occupational Safety and Health Standards"
- c. NPD 1800.2, "NASA Occupational Health Program"
- d. NPD 1810.2, "NASA Occupational Medicine Program"
- e. NPD 1820.1, "NASA Environmental Health Program"

**P5. Cancellation**

This handbook replaces JPR 1700.11.

# Chapter 1.4

## Written safety and health program

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### 1. Applicability of this chapter

You are required to follow this chapter if you:

- a. Need guidance on safety and health requirements or standards.
- b. Need a ~~variance~~-waiver to any safety and health requirement.
- c. Need to recommend changes to center-level safety and health requirements.
- d. Maintain center safety and health requirements.
- e. Maintain safety and health documentation for your organization.

### 2. Description of Sub-element 1.4

This Handbook contains JSC's written safety and health program. Parts 1–4 cover all major elements of VPP and their sub-elements. Our program also meets the requirements in 29 CFR 1960 and all federal and NASA safety and health policies and requirements. Parts 5–11 include safety and health requirements for specific tasks or situations. The Handbook is available on line through the JSC Safety and Total Health Homepage. It is a controlled document, and the on-line version is the official version. Check the on-line version to verify that you are using the current requirements.

### 3. OSHA, federal, and other standards to follow

You shall follow safety and health standards issued under the Occupational Safety and Health Act and other federal regulations. This includes the following standards:

- a. **OSHA standards.** JSC shall follow safety and health standards issued by OSHA under Section 6 of the Occupational Safety and Health Act. We may follow alternate or supplementary standards that NASA Headquarters and the Secretary of Labor approve as described in 29 CFR 1960.17, "[Basic Program Elements for Federal Employees OSHA](#)." This Handbook references any alternate standards that exist for NASA in the appropriate chapters.
- b. JSC shall follow these **other federal standards**:
  1. Federal Aviation Administration standards applicable to public aircraft, since NASA operates its aircraft as public aircraft
  2. Department of Transportation standards for shipping and handling hazardous materials
  3. Environmental Protection Agency standards for recovering, controlling, and disposing of hazardous wastes
  4. Nuclear Regulatory Commission standards for handling radioactive sources
  5. The American Disabilities Act requirements for disabled employees

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## Part 1, Management leadership and employee involvement

- c. JSC shall follow any *consensus standards* referenced in this Handbook.

### 4. NASA and JSC requirements and standards to follow

You shall follow any NASA Headquarters safety and health requirements and standards called out in this Handbook such as:

- b. NASA Policy Directives (NPDs)
- c. NASA Procedural Requirements (NPRs)
- d. NASA or JSC Standards
- e. JSC Policy Directives (JPDs)
- f. JSC Procedural Requirements (JPRs)

You shall follow any NASA, JSC, or other standards as well as NPDs, NPRs, JPDs, and JPRs referenced in this Handbook.

### 5. Standards for JSC civil service employees working at another site

If you work at a non-JSC site, you shall:

- a. Follow local requirements and standards if another NASA center or federal agency oversees the site.
- b. Follow JSC or local requirements and standards at other sites (including foreign countries), whichever is more stringent.
- c. Tell your management if the requirements or standards at another federal agency's requirements conflict with NASA, JSC, or OSHA standards and:
  - 1. Follow the most stringent standards until the conflict is resolved.
  - 2. If the conflict involves NASA standards, your management shall tell the NASA-designated safety and health official of the conflict.
  - 3. If the conflict involves OSHA standards, the NASA-designated safety and health official tells the Secretary of Labor and the other federal agency of the conflict so that it can be resolved.

### 6. ~~Variance~~Waivers to safety and health requirements and standards

~~Variance~~Waivers are a means to get authorization to take a different approach to meet the intent of the requirement, rather than to ignore requirements. NASA does not have the authority to waive Federal, State, or Local requirements, but may waive NASA requirements. To get a ~~variance~~waiver to NASA or JSC requirements, you shall:

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## Chapter 1.4, Written safety and health program

- a. ~~Prepare a written request for variance that includes~~ Follow the process in paragraph 4.2, JPR 1410.2, “JSC Directives Procedural Requirements,” ~~for waivers to JSC-level requirements.~~
- a-b. ~~Follow the process in paragraph 1.13, NPR 8715.3, NASA General Safety Program Requirements, for relief from Agency-level Safety and Mission Assurance requirements,” as well as paragraph 4.2.2 of JPR 1410.2.~~
1. ~~What the variance is. Reference the requirement or standard. Search the requirement to its original source. Some NASA or JSC requirements may actually be OSHA requirements.~~
  2. ~~The time period for the variance. List a date range or “indefinite.”~~
  3. ~~The reason you need the variance. Give detailed justification on why you can’t follow the requirement or standard.~~
  4. ~~A risk assessment to determine whether the risk increases with countermeasures in place.~~
  5. ~~Actions taken to control the hazard, such as how you will provide equal protection to your employees. If you don’t provide equal protection, you shall justify the increased risk.~~
  6. ~~A plan for correcting any deficiencies with expected completion dates or milestones for achieving compliance.~~
  7. ~~Approval signature from your director or program manager (director level).~~
- b. ~~Send the request to the Director, Safety and Mission Assurance Directorate, or Director, Space Life Sciences, for health requirements, who will approve or disapprove the request and send it to higher management for more approvals if necessary.~~
- c. ~~This table tells you who shall approve certain variances and what other requirements apply.~~

<i><b>Variances to . . .</b></i>	<i><b>Shall be approved by . . .</b></i>	<i><b>Requirements and comments . . .</b></i>
JSC requirements or standards	Director, JSC (with concurrence from the Director, S&MA,; Director, Space Life Sciences; concurrence is necessary for variances to health requirements)	• The approval shall include an acceptance of risk if there is an increase in the risk level.
NASA Headquarters program-level safety and health requirements	NASA Headquarters through the Director, S&MA (or Director, Space Life Sciences, for health requirements), and the Center Director	• You can find NASA’s variance policy in paragraph 1.13 of NPR 8715.3, “NASA General Safety Program Requirements,” current version.

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## Part 1, Management leadership and employee involvement

NASA Headquarters project-level safety and health requirements	Center Director through the Director, S&MA (or Director, Space Life Sciences, for health requirements)	<ul style="list-style-type: none"> <li>• JSC shall provide copies of these variances to NASA Headquarters, Office of Safety and Mission Assurance.</li> <li>• The approval shall include an acceptance of risk, if there is an increase in the risk level.</li> <li>• You can find NASA's variance policy in paragraph 1.13 of NPR 8715.3, "NASA General Safety Program Requirements," current version.</li> </ul>
OSHA standards	Secretary of Labor through the Director, S&MA (or Director, Space Life Sciences, for health requirements), Center Director, and NASA Headquarters	<ul style="list-style-type: none"> <li>• Requests shall include a very detailed justification and an alternate standard that provides equal or greater protection.</li> <li>• This process takes at least 3 months.</li> <li>• OSHA rarely approves variances.</li> <li>• See 29 CFR 1905, "Rules of Practice for Variances, Limitations, Tolerances, and Exemptions."</li> </ul>
Other federal, state, or local standards such as Environmental Protection Agency (EPA), Department of Transportation (DOT), or Texas Natural Resources Commission (TNRCC)	NASA Headquarters and the agency that issued the standard	<ul style="list-style-type: none"> <li>• See the standard for details on how to get a variance.</li> <li>• JSC's Environmental Services Office shall also approve requests for variances from any environmental protection standard such as EPA or TNRCC.</li> </ul>
Consensus standard	Whoever the standard authorizes	<ul style="list-style-type: none"> <li>• See the standard.</li> <li>• JSC may be allowed to approve a variance.</li> </ul>

## 7. Changing this Handbook

We may change this Handbook due to changes in higher-level requirements or due to better ways of doing business. ~~The following flowchart outlines the process for suggesting and making To suggest changes to this Handbook, follow the center-wide process for updating existing JSC directives in paragraph 4.4, JPR 1410.2, "JSC Directives Procedural Requirements."~~ ~~Your change request shall include the following:~~

~~6. The paragraph and subparagraph reference and page number.~~

~~7. The suggested change.~~

~~8. Reason for the change.~~

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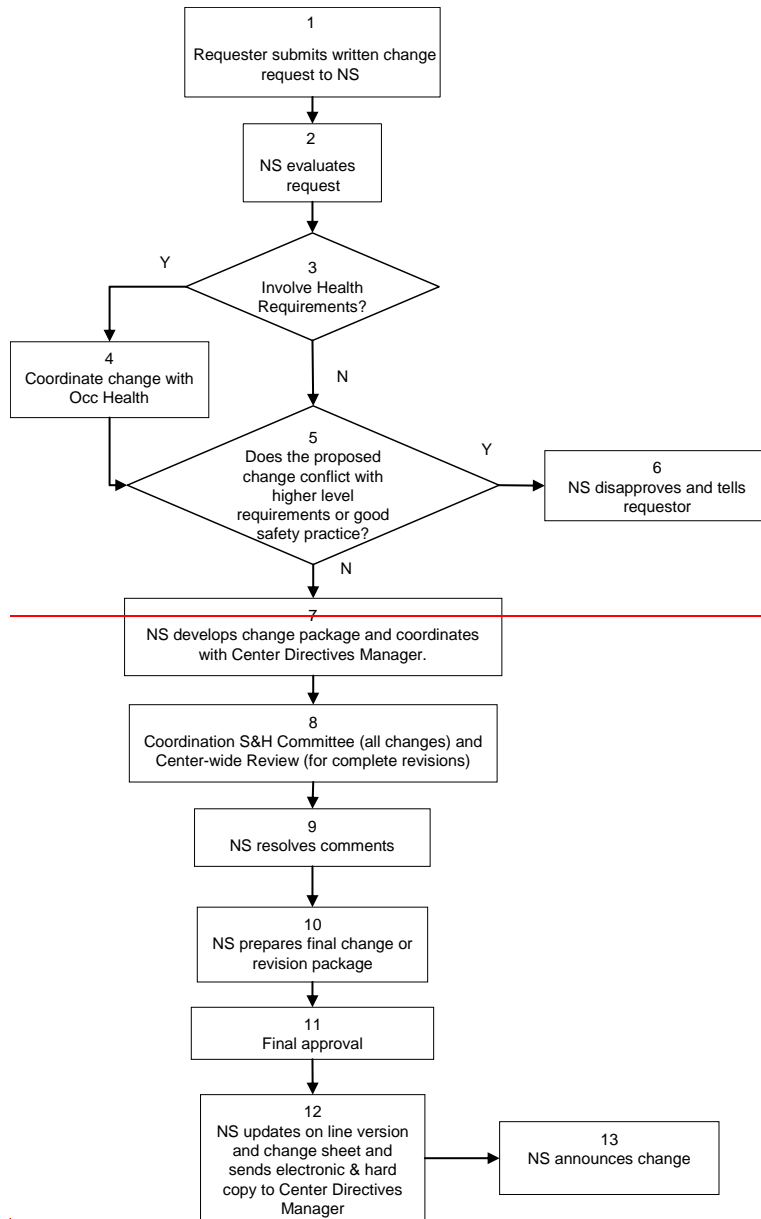
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## Chapter 1.4, Written safety and health program



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## Part 1, Management leadership and employee involvement

### 8. Responsibilities

The JSC Safety and Test Operations Division (NS) is responsible for maintaining this Handbook and posting changes to the Safety and Health Homepage.

### 9. Safety and health records

The following records document JSC's safety and health program:

- a. Center-level records:
  1. Current JPR 1700.1
  2. Change records to JPR 1700.1
  3. ~~Variance Waiver~~ documentation. ~~—JSC shall send copies of any variances that JSC approves to NASA level requirements to NASA Headquarters, Office of Safety and Mission Assurance.~~
- b. Organizational-level records – No organizational-level records are required. You are encouraged to keep copies of variances granted for your work areas.



# Chapter 2.4

## Hazard Analysis

### 1. Applicability of this chapter

You are required to follow this chapter if you:

- a. Do job hazard analyses or hazard analyses.
- b. Are a project manager, Contracting Officer, JSC's Center Director, or the Director, Safety and Mission Assurance, Paragraph 17 of this chapter lists your responsibilities.

### 2. Description of Sub-element 2.4

JSC shall routinely examine and analyze safety and health hazards associated with individual jobs, processes, or phases and include results in training and hazard control programs described in Chapter 3.2 of this Handbook. This may include job hazard analysis, hardware or facility hazard analysis, or process hazard review.

### 3. What this chapter covers

This chapter gives you basic requirements for doing job hazard analyses and other hazard analyses and for managing risk for ground-based jobs and systems. See space shuttle or space station requirements for more information on space systems.

NOTE: Your hazard analysis may also include the required environmental impact assessment to make sure all environmental aspects have been considered and the impacts are controlled. The assessment is required by JSC's Environmental Management System to assess JSC's activities, products, or services that have effects on the environment – both positive and negative. It shall follow JPR 8553.1, "JSC Environmental Management System Manual."

### 4. Job hazard analysis

The following requirements apply:

- a. You shall do a job hazard analysis for any job you believe to be hazardous. In this chapter, "job" means a task that someone does, not his or her position.
- b. Before each hazardous operation, you shall assess any unique hazards and controls and affirm the appropriateness of the work-authorizing document. If the existing work-authorizing document is insufficient to adequately control the hazards, you shall:
  1. Assess the hazards using a Safe Plan of Action (see JSC 17773) or equivalent assessment.
  2. Include any necessary controls in the work effort. The job hazard analysis will be made available if necessary.

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## Part 2, Worksite analysis

3. Return a copy of the completed assessment to the work authorizing document's originator to determine whether the document should be updated.
- c. You shall review your job hazard analysis yearly or when the job changes, and update it as needed.
- d. Job hazard analysis shall follow Appendix ~~BG~~ of JSC 17773, "Preparing Hazard Analyses for JSC Ground Operations." (current version). Appendix ~~BG~~ of JSC 17773 follows the format and methodology of OSHA pamphlet 3071, "Job Hazard Analysis."

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## 5. When a hazard analysis is required

A hazard analysis is an organized method for identifying hazards and hazard controls in a system at any point in its life cycle. JSC 17773 gives you more details on how to recognize and analyze hazards. You shall start planning for and doing hazard analyses and environmental impact assessments in the early design phases for any of the following systems and operations:

- a. Aircraft systems.
- b. New facilities, modifications to facilities that affect previously approved hazard controls or introduce new hazards, and hazardous facility systems such as test or oxygen systems.
- c. Hazardous operations such as:
  1. Operations involving explosives.
  2. Operations in extreme temperatures.
  3. Operations involving lasers.
  4. Operations involving cryogenic materials.
  5. Operation of reduced pressure chambers.
  6. Operation of lifting devices
- d. Support equipment such as test, maintenance, or training equipment.
- e. Software for any of the above systems.
- f. Prototypes of any of the above systems.
- g. Other systems or operations when required by other chapters of this Handbook.
- h. Operations and support activities, such as:

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1. Constructing facilities and making hardware.
2. Experimenting on and testing systems.
3. Storing, packing, or transporting systems.
4. Checking out and using systems.
5. Maintaining or modifying systems.

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## Chapter 2.4, Hazard Analysis

6. Retrieving, disassembling, or disposing of systems.

7. Testing and human research.

2-i. Others as determined by the Safety and Test Operations Division and in consultation with affected organization if additional hazard analysis is required.

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### 6. Basic elements of a system safety program

A system safety program may be simple or complex, depending on the project. You shall follow these steps and may tailor them to your project:

- a. Start with a preliminary hazard analysis on each proposed concept.
- b. Use the preliminary hazard analysis to:
  1. Document the hazards of each design concept or operation you are considering.
  2. Review lessons learned from past experience.
  3. Define safety and health requirements for the project.
  4. Help you select which design concepts or operations to choose.
  5. Plan future safety and health efforts. These could include what other hazard analyses and system safety techniques are necessary, such as subsystem hazard analyses, operation and support hazard analyses, fault-tree analyses, and hazard operability studies.
- c. Use hazard analyses to support trade-off studies of different design and operational concepts during each phase of the project.
- d. Trace all pertinent details of the hazard analysis and review from the initial identification of the hazard through its resolution and any updates. Use the continuous risk management approach.
- e. Decide which hazard controls to use. Eliminate hazards with design measures as much as possible. Use other controls for those you can't eliminate by design.
- f. Analyze your system's proposed operation for hazards. Consider all phases of your system's operation such as test, startup, operation, maintenance, and disposal.
- g. Decide what risk is acceptable to your project.
- h. Assess and accept the risks of the system or its operation after you have controlled the hazards by:
  1. Using the most effective hazard controls that will be cost effective and won't prevent the system's mission from being accomplished.
  2. Looking at the risk each hazard poses and deciding whether it's acceptable or whether you should do more to control it and lower the risk.
- i. Have the right level of management accept risks.
- j. Document all risk decisions and their rationale.

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## Part 2, Worksite analysis

- k. Send copies of safety analysis reports and hazard analyses to NASA Headquarters as requested.
- l. Also see paragraphs 2.3 and 2.4 of NPR 8715.3, "NASA General Safety Program Requirements," for more information on the flow of a system safety program.

### 7. What hazard analyses contains

Your hazard analysis shall contain at least the following information:

- a. The system's name and location.
- b. The hazards of the system and their causes. Include hazards from human factors as well. You shall also consider hazards of interfaces between systems, and interfaces between the equipment and the facility.
- c. The consequence of each hazard if it were to cause a mishap. For example, death, major injury, minor injury, or estimated property damage and dollar amount.
- d. Any existing engineering or administrative controls for each hazard.
- e. Proposed engineering or administrative controls for each hazard, if the existing controls are inadequate.
- f. Verification methods for each control to explain how the presence of each control will be confirmed. This shall also include a traceable reference to the specific document(s) where completion of the verification will be recorded (Examples include test procedure, facility checklist, operator certification documentation, document or drawing number)... Document completion of each verifications independently outside of the hazard analysis (e.g., review of procedures, inspections, etc.).
- g. What would happen if the engineering or administrative controls were to fail.
- h. A qualitative evaluation of the possible safety and health effects before and after the controls are in place.
- i. Who was on the team that did the hazard analysis.
- j. When was the last time you analyzed the system.
- k. A qualitative evaluation of the risk before and after the hazard controls are in place. This is the risk that management will have to accept.

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~~3-~~ Note: Job Hazard Analyses follow the content specified in paragraph 4 above.

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### 8. Required review and concurrence of a hazard analysis

The following shall review and concur via signature each hazard analysis:

- a. Hazard Analysis Author.
- b. Facility Manager or Test Director.

Field Code Changed

## Chapter 2.4, Hazard Analysis

- c. Branch or Division Chief, depending on accepted risk, or designee (see paragraph 10 in this chapter for required approval authority).
- d. Safety and Test Operations Division representative.
- e. Board or committee that approves tests or human research.
- f. Others per the discretion of the Supervisor or Chair of a review board.

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### 89. Assessing risk

You shall use the risk assessment code (RAC) matrix below to assess the risk of each hazard. To use this matrix:

a.g. Find the “consequence” or the worst-case outcome of a mishap from the hazard along the left side of the matrix. The possible consequences are:

1. Class I – Catastrophic. A condition that may cause death or permanently disabling injury, facility destruction on the ground, ~~or loss of crew, major systems, or vehicle during the mission; schedule slippage causing launch window to be missed; cost overrun greater than 50% of planned cost.~~
2. Class II – Critical. A condition that may cause severe injury or occupational illness, or major property damage to facilities, systems, equipment, or flight hardware; ~~schedule slippage causing launch date to be missed; cost overrun between 15% and not exceeding 50% of planned cost.~~
3. Class III – Moderate. A condition that may cause minor injury or occupational illness, or minor property damage to facilities, systems, equipment, or flight hardware; ~~internal schedule slip that does not impact launch date; cost overrun between 2% and not exceeding 15% of planned cost.~~
4. Class IV – Negligible. A condition that could cause the need for minor first-aid treatment but would not adversely affect personal safety or health; damage to facilities, equipment, or flight hardware more than normal wear and tear level; ~~internal schedule slip that does not impact internal development milestones; cost overrun less than 2% of planned cost.~~

b.h. Find the “likelihood” that you expect the mishap to occur across the top of the matrix. The possible likelihood estimates are:

1. Likelihood A. Likely to occur ~~(e.g., probability > 0.1).~~
2. Likelihood B. Probably will occur ~~(e.g., 0.1 ≥ probability > 0.01).~~
3. Likelihood C. May occur ~~(e.g., 0.01 ≥ probability > 0.001).~~
4. Likelihood D. Unlikely to occur ~~(e.g., 0.001 ≥ probability > 0.000001).~~
5. Likelihood E. Improbable ~~(e.g., 0.000001 ≥ probability).~~

e.i. Find the RAC in the box where the “consequence” and “likelihood” cross.

#### LIKELIHOOD ESTIMATE

Field Code Changed

## Part 2, Worksite analysis

CONSEQUENCE CLASS	A	B	C	D	E
I	1	1	2	3	4
II	1	2	3	4	5
III	2	3	4	5	6
IV	3	4	5	6	7

### 910. What each RAC means

The table below tells you what action to take for each RAC. For systems in design, you shall eliminate or control the hazard before the system goes into operation. For existing systems, investigate and abate the hazard as described in Chapters 3.2 and 3.5 of this Handbook.

<i>If the RAC is . . .</i>	<i>Then the risk is . . .</i>
1	Unacceptable – All operations shall cease immediately until the hazard is corrected, or until temporary controls are in place and permanent controls are in work.  A safety or health professional shall stay at the scene at least until temporary controls are in place.  RAC 1 hazards have the highest priority for hazard controls.
2	Undesirable – All operations shall cease immediately until the hazard is corrected or until temporary controls are in place and permanent controls are in work.  RAC 2 hazards are next in priority after RAC 1 hazards for control.  Program Manager (director level), Organizational Director, or equivalent management is authorized to accept the risk with adequate justification
3	Acceptable with controls – Division Chief or equivalent management is authorized to accept the risk with adequate justification
4–7	Acceptable with controls – Branch Chief or equivalent management is authorized to accept the risk with adequate justification

### 110. Controlling hazards

You shall use these steps to decide what corrective action to take for any hazard found during your analysis. Take the following actions in the order below to control a hazard. Go to the next step only if the present step or previous steps aren't feasible or are too costly:

- Change the design to eliminate or reduce the hazard. For example, use a less hazardous material or lower voltage if you can.
- Install safety devices or guards. For example, use safety interlocks, machine guards, or relief valves if you can.

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## Chapter 2.4, Hazard Analysis

- c. Install caution and warning devices. For example, use oxygen monitors or alarms if you can.
- d. Use administrative controls, such as special work procedures, training, administrative barriers, and signs.
- e. Use personal protective equipment.
- f. Accept the risk as described in subparagraphs 6.h and 6.i of this chapter.
- g. Make sure that all hazards are controlled. To do this, you shall track each hazard and keep it “open” until one of the above actions has occurred.

### *System safety plan and reviews*

#### **121. System safety plan**

As a project manager, you shall develop a system safety program plan that describes your system safety effort. You may combine this with a safety and health plan, if possible. Use Attachment 2.4A, Appendix 2B, as a guide. The plan shall:

- a. Be done before the project begins.
- b. Describe engineering and management tasks for system safety.
- c. Tailor the system safety program to the project based on the project’s complexity, cost, criticality, or management structure.
- d. Allow for free communications among all persons and organizations working on the project.
- e. Be updated as the design matures.
- f. Include budgets, responsibilities, and applicable safety and health requirements.
- g. Include a system safety task schedule that supports the project schedule.

#### **132. Safety reviews**

As a project manager, you need to have a safety review either before or as a part of each project review. Project reviews may include preliminary design reviews or 30% design review, operational readiness inspections, etc. Safety reviews shall:

- a. Status your system safety program.
- b. Review hazards found before the review and prioritize them by risk.
- c. Review other system safety products such as safety assessment reports.
- d. Decide whether you should change the design, study other options, or do more hazard analysis.

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## Part 2, Worksite analysis

### *Other requirements and responsibilities for hazard analyses and job hazard analyses*

#### **143. Maintaining a hazard analysis or job hazard analysis**

You shall:

- a. Keep the analysis and review it at least every 5 years while the project is active or before making any changes to the hardware, software, or operation. This will allow you to see how valid your analysis was after you have had some experience with the system.

Include the findings of the hazard analysis in the operational procedures to ensure that personnel performing the procedures are aware of the hazards and take appropriate actions.

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- b. Review job hazard analyses every year or when the job changes.

Review hazard analyses submitted to the Committee for the Protection of Human Subjects for human research each year

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#### **154. Changes to the job, system, or operation**

If you intend to change your job, system, or operation, including changes to process or chemicals used in a process, you shall:

- a. Hold a safety review, update the existing hazard analysis, or do a new hazard analysis to make sure that the change doesn't create a hazard.
- b. Analyze any change proposed to correct a hazard to see whether it will effectively control the hazard.
- c. Include in the hazard analysis a listing of chemicals used in the process. Update the hazard analysis whenever quantities increase or processes change.

#### **165. Other requirements for ~~job~~ hazard analyses and job hazard analyses**

In addition to this chapter, you shall follow the requirements in these documents.

<i>For . . .</i>	<i>Follow this standard . . .</i>
Job hazard and hazard analyses on JSC ground-based systems	<del>JSC 4773</del> NPR 8715.3, Chapter 2 NASA STD 8719.7, "Facility System Safety Guidebook"
Software safety	NASA STD-8719.13, "Software Safety"
Failure tolerance requirements for safety-critical functions	Paragraph 1.7 of NPR 8715.3

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JPR 1700.1

2.4-8

Rev. J. Change 2 (~~August April~~ 201108)

Verify this is the correct version before you use it by checking the online version.



## Chapter 2.4, Hazard Analysis

Product safety	29 CFR 1960.34(b)
Ground-based chemical processes	29 CFR 1910.119
Environmental impact assessments of new or different activities, products, or services	JPR 8553.1, "JSC Environmental Management System Manual"

### 176. For more information on job hazard and hazard analyses

You can find more information on job hazard and hazard analyses in these documents:

- a. Chapter 2 and Appendix F of NPR 8715.3, "NASA General Safety Program Requirements," current version.
- b. Langley Research Center Handbook 1740.4, "Facility System Safety Analysis and Configuration Management," current version.
- c. NPR 8820.2, "Facility Project Implementation Guide," current version.
- d. MIL-STD-882, "System Safety Program Requirements," current version.
- e. JSC 17773, "Preparing Hazard Analyses for JSC Ground Operations." (current version)

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### 187. Responsibilities

Responsibilities for hazard analysis and job hazard analysis are as follows:

- a. The **Center Director** has the final authority for all system safety products and risk management decisions for systems and facilities at JSC and JSC field sites. He or she is responsible for appointing a senior manager at JSC and each field site to serve as the site manager for risk management decisions involving JSC personnel, property, and operations.
- b. A **project manager** for any new or modified system, facility, or operation at JSC or a JSC field site is responsible for:
  1. Developing a system safety program for your project early in the planning phase.
  2. Making sure everyone on the project follows your system safety program.
  3. Approving a safety management plan and any system safety program plans that may be required.
  4. Reporting hazards that could result in death, major injury, or major property damage to anyone or anything outside the project and other hazards, as required, to higher management.
  5. Fulfilling the responsibilities in paragraphs 2.5, 2.6, 2.7, and 2.8 of NPR 8715.3.
- c. The **Director, Safety and Mission Assurance Directorate**, is responsible for providing personnel to:

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## Part 2, Worksite analysis

1. Providing guidance to JSC organizations on system safety programs, job hazards, and hazard analyses. Reviews programs and analyses.
  2. Making sure system safety products are complete and accurate and management is properly accepting risk and documenting its decisions.
  3. Supporting project and safety reviews to make sure the system safety program is being followed.
  4. Fulfilling the responsibilities in paragraphs 2.5, 2.6, 2.7, and 2.8 of NPR 8715.3.
- d. The ***Clinical Services Branch*** is responsible for helping JSC organizations conduct job hazard or hazard analyses for potential occupational health hazards in the workplace.

### **198. Safety and health records**

The following organizational-level records document hazard analysis:

- a. Organizational-level records:
  1. Line managers and employees shall keep current copies of job hazard analyses.
  2. Ground programs shall keep copies of system safety plans and hazards.
- b. Center-level records – Records on environmental impact assessments are maintained in the Environmental Management System Control plan as described in JPR 8553.1, “JSC Environmental Management System Manual.”

Field Code Changed

# Chapter 2.5

## Routine inspections

### 1. Applicability of this chapter

You are required to follow this chapter if you work at JSC or a JSC field site. Paragraph 14 of this chapter lists the responsibilities of facility managers, line managers, contractor safety representatives, the Safety and Test Operations Division, and the Clinical Services Branch.

### 2. Description of Sub-element 2.5

JSC shall have a system for routinely inspecting selected work areas monthly so as to cover the entire site quarterly. This routine inspection:

- Is done by employees trained in recognizing hazards and may include other employees.
- Follows written procedures or guidance.
- Results in written reports of findings.
- Tracks hazard elimination or control to completion.

### 3. Purpose of safety, fire, and health inspections and evaluations

Safety and health inspections and evaluations identify hazards in the workplace so they can be corrected.

### 4. Safety, fire, and health inspections and evaluations at JSC

This table lists the kinds of safety, fire, and health inspections and evaluations JSC does. Inspections shall look for safety, fire, and health hazards unless otherwise noted.

<i>What kind?</i>	<i>Who does them?</i>	<i>How often?</i>
Construction area self-inspections to find hazards	<ul style="list-style-type: none"><li>Construction company managers and employees</li><li>Directorate safety and health committee members</li></ul>	<ul style="list-style-type: none"><li>Weekly</li><li>Monthly by directorate safety and health committee members</li></ul>
Regular safety, fire, and health inspections to find hazards	<ul style="list-style-type: none"><li>Safety and Test Operations Division</li><li>Clinical Services Branch</li></ul>	<ul style="list-style-type: none"><li>Yearly, or more often if necessary</li></ul>

## Part 2, Worksite analysis

<i>What inspections?</i>	<i>Who does them?</i>	<i>How often?</i>
Director walkthroughs	<ul style="list-style-type: none"> <li>Organizational directors</li> </ul>	<ul style="list-style-type: none"> <li>Twice a year</li> </ul>
Facility manager walk-throughs to inspect for safety, health, and fire hazards	<ul style="list-style-type: none"> <li>Facility managers are responsible for making sure their buildings are inspected</li> <li>Managers responsible for the work area, and employees in the work area may also participate or do separate inspections</li> </ul>	<ul style="list-style-type: none"> <li>Inspect a few areas monthly and cover the entire building quarterly</li> </ul>
Special inspections and surveys to look at suspected hazards	<ul style="list-style-type: none"> <li>Safety and Test Operations Division</li> <li>Occupational Health Branch</li> </ul>	As requested by safety and health committees, employee representatives, or employees After an employee complaint
Unannounced inspections to find hazards	<ul style="list-style-type: none"> <li>Safety and Test Operations Division</li> <li>Clinical Services Branch</li> </ul>	As needed
Follow-up inspections to make sure hazards are corrected	<ul style="list-style-type: none"> <li>Safety and Test Operations Division</li> <li>Clinical Services Branch</li> </ul>	As necessary to make sure hazards are corrected
Baseline surveys get a baseline on hazards of new and newly acquired facilities, processes, materials, or equipment	<ul style="list-style-type: none"> <li>Operational readiness inspections</li> <li>User readiness reviews</li> <li>Informal survey teams</li> <li>Safety, fire, and health professionals</li> </ul>	Before the new or newly acquired facilities, processes, materials, and equipment are used

### 5. Fire risk surveys

The Safety and Test Operations Division surveys all JSC work areas and operations periodically, or when a facility is built or modified. The fire risk survey isn't intended to be an all-encompassing engineering survey, but will try to find obvious fire hazards with normal facility operations. The survey shall look at areas such as:

- Exit routes and posted facility evacuation plans.
- Manual and automatic fire detection systems.
- Manual and automatic fire suppression equipment.
- Heating, ventilation, and air conditioning systems, if accessible.
- Normal and emergency lighting systems and power systems.
- Separation and protection of hazardous operations and material.
- Elevators.
- The adequacy and reliability of the water supply.

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## Chapter 2.5, Routine inspections

- i. Fire department response.
- j. Alarm monitoring equipment.
- k. Emergency procedures to include Emergency Action Plans.
- l. Existing fire risk analysis and inspection results.
- m. Other fire safety features as deemed necessary.

NOTE: For correcting deficiencies, see also Chapters 3.2, “Hazard Elimination and Control,” and 3.5, “Hazard Correction Tracking,” of this Handbook.

### 6. Inspections of inactive work areas or equipment

For inactive work areas or equipment, you shall:

- a. Inspect inactive work areas or equipment at least yearly.
- b. Hold a thorough readiness review to identify hazards and take necessary actions to correct all hazards if you plan to reactivate inactive work areas or equipment.

### 7. Preparing for an inspection

As a line manager, whether you are doing a self-inspection or being inspected by someone else, you shall:

- a. Gather and review all safety, fire, and health information such as safety, fire, and health procedures, injury and illness records, previous inspection reports, hazard reports, and corrective action reports. Give outside inspectors the results from your last self-inspection.
- b. Decide what you will inspect. You may restrict your own inspections to only areas where your employees work. Suggest what areas to inspect to outside inspectors.
- c. Stop operations that could be hazardous to those on the inspection.
- d. Provide special passes or badges for outside inspectors if necessary. Make arrangements with the Security Branch ahead of time if needed.
- e. Provide necessary personal protective equipment to your employees who go on the inspection. Tell outside inspectors what personal protective equipment they need to bring such as hard hats, safety shoes, or respirators before the inspection if possible. Provide outside inspectors with personal protective equipment that is unique to your work area such as gloves or suits. Everyone on the inspection shall use personal protective equipment as required.
- f. Arrange for employee representatives to participate. Employee representatives aren’t required, but shall be given the opportunity to participate.
- g. Employees or employee groups shall have the opportunity to choose employee representatives.

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## Part 2, Worksite analysis

### 8. Inspections by individuals or small teams

To do a self-inspection:

- a. Find all the safety, fire, and health hazards you can by:
  1. Using checklists you develop or checklists from the Safety and Test Operations Division or the Clinical Services Branch.
  2. Using standards from this Handbook, NASA requirements, or OSHA requirements.
  3. Questioning any condition you think may cause a mishap.
- b. Question employees in the work areas about safety, fire, and health matters.
- c. Keep records of your inspections, and track the hazards to closure. Records shall include at least the following information:
  1. What hazards you find
  2. When and where (building and room) you found them
  3. What actions you take to correct the hazards
  4. When you correct each hazard
- d. Correct hazards on the spot, if possible.
- e. Ask the Safety and Test Operations Division or the Clinical Services Branch for a special inspection or industrial hygiene survey for things you aren't sure of.
- f. Tell all employees the inspection results.
- g. Correct all hazards within a reasonable amount of time as described in Chapter 3.5.

Certified industrial hygienists, certified safety professionals, professional engineers, and other safety, fire, and health professionals are available to help you with inspections and hazard correction as needed.

### 9. Inspections by the Safety and Test Operations Division or the Clinical Services Branch

Safety, fire, and health inspectors are authorized to enter any work area that isn't hazardous to themselves or your employees. You shall cooperate with safety and health inspectors when they enter your work areas. They have the right to refuse to allow anyone to accompany them who would interfere with a fair and orderly inspection. Safety, fire, and health inspectors shall follow any special procedures you have for entering your work areas. The inspectors:

- a. Review safety, fire, and health information before the inspection, or ask for it when they arrive.
- b. Bring the materials and equipment they need for the inspection such as checklists, personal protective equipment, and monitoring equipment. They won't bring any personal protective equipment that is unique to your work area.

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## Chapter 2.5, Routine inspections

- c. Hold an opening conference to tell managers and employees what they plan to inspect. They may inspect an entire building or work area, or just a part of a work area.
- d. Keep records on their findings. They will note any hazards corrected on the spot and make sure inspection records reflect the corrections.
- e. Interview employees and managers in the work areas. Employees interviewed have the right to bring any hazards to the attention of the inspectors.
- f. Tell the manager in charge of a work area about any condition that they reasonably expect could cause death or serious injury immediately. That manager shall correct the condition immediately or take temporary measures to protect his or her employees.
- g. Hold an exit conference to discuss the inspection results with managers and employees.
- h. Send the manager in charge and the facility manager a written report on the inspection that will include the procedures followed for the inspection and findings. Include any conditions that require a JSC Form 1240, "JSC Notice of Safety or Health Hazard and Action Plan," as described in Chapter 3.5. Reports on safety inspections are sent within 15 days. Reports on health inspections or surveys are sent within 30 days after completion.
- i. Track open hazards in the Hazard Abatement Tracking System kept by the Safety and Test Operations Division. See Chapter 3.5 for more details.

### 10. Follow-up to an inspection

After you, as a manager, finish the exit conference of an inspection, you shall:

- a. Tell all employees the inspection results.
- b. Develop action plans to correct all hazards within a reasonable amount of time as described in Chapter 3.5.
- c. Post JSC Form 1240 after you get the written report. Keep each form posted for at least 3 days or until the hazard is corrected.

### 11. Inspections by OSHA, National Institute for Occupational Safety and Health (NIOSH), or the Nuclear Regulatory Commission (NRC)

When OSHA, NIOSH, or NRC representatives come to inspect JSC work areas, JSC shall:

- a. Allow them to enter any JSC workplaces, whether occupied by government or contractor employees, to inspect or evaluate workplace conditions. The Security Branch will handle access to secure areas.
- b. Require them to show identification, and receive any necessary security clearances.
- c. Give the inspectors:
  - 1. Safety, fire, and health information on the worksites they will visit

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## Part 2, Worksite analysis

2. Photographic support, as needed and if available
- d. Arrange for them to interview employees during their visit.
- e. Escort them during their visits. The following persons shall escort them:
  1. Representatives of any contractors who work in the work area to be inspected
  2. A representative from the Clinical Services Branch for NIOSH visits and OSHA visits that involve health issues
  3. A representative of the Safety and Test Operations Division for OSHA visits; a representative of the Safety and Test Operations Division may also escort NIOSH visitors
  4. A representative from the Radiation Safety Office for NRC, NIOSH, or OSHA visits that involve radiation issues
  5. A manager or employee representative from the work area to be inspected
- f. Keep OSHA and NIOSH reports on civil service employee areas at the Safety and Test Operations Division or the Clinical Services Branch.
- g. Notify NASA Headquarters Safety and Mission Assurance, the Chief Health and Medical Officer, and the Designated Agency Safety and Health Official of any impending inspections or investigations, and send the results of the inspection to NASA Headquarters Safety and Mission Assurance.

## 12. OSHA or NIOSH inspections of contractor areas

You shall provide the following to the Safety and Test Operations Division and the Clinical Services Branch within 10 working days after you get the OSHA or NIOSH report:

- a. A copy of the report
- b. A summary of any findings
- c. A summary of actions you will take to correct the findings

## 13. For more information on safety and health inspections

You can find more information on safety and health inspections in these documents:

- a. 29 CFR 1910, "Occupational Safety and Health Standards, General Industry"
- b. 29 CFR 1926, "Occupational Safety and Health Standards, Construction Industry"
- c. 29 CFR 1960, "Basic Program Elements for Federal Employee Occupational Safety and Health Programs and Related Matters"
- d. *A Strategy for Occupational Exposure Assessment*, Editor Neil C. Hammond, American Industrial Hygiene Association, Akron, Ohio, 1991

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## Chapter 2.5, Routine inspections

### 14. Responsibilities

Responsibilities for safety, fire, and health inspections are as follows:

- a. As a JSC *facility manager*, you are responsible for:
  1. Making sure that self-inspections are done in your building as described in paragraphs 4, 5, 6, and 7 above. You may count inspections by line managers or employees. This includes making sure documentation of the inspections is available.
  2. Doing a complete safety walkthrough of your building at least once a year to inspect for safety, health, and fire hazards. You may fulfill this by accompanying Safety and Test Operations Division personnel on their annual inspections.
  3. Making sure action is taken on all inspections as described in paragraph 10 above.
- b. As a JSC *line manager*, you are responsible for:
  1. Making sure that self-inspections are done in your work areas as described in paragraphs 4, 5, 6, and 7 above. You may count inspections by line managers or employees. This includes making sure documentation of the inspections is available.
  2. Making sure action is taken on all inspections as described in paragraph 10 above.
  3. Involving employees in safety and health inspections.
- c. As a *contractor safety representative*, you are responsible for helping contractor or NASA safety and health inspections as necessary.
- d. The *Safety and Test Operations Division* and the *Clinical Services Branch* are responsible for:
  1. Having qualified safety, fire, and health inspectors.
  2. Making sure safety and health inspectors have enough documented training and experience in finding, evaluating, and correcting hazards.
  3. Noting health issues during safety inspections and reporting them to the Clinical Services Branch.
  4. Noting safety issues during health inspections and reporting them to the Safety and Test Operations Division.
  5. Notifying NASA Headquarters, Office of Safety and Mission Assurance, of OSHA or NIOSH inspections or investigations of JSC or contractor operations.
  - 5.6. Make sure audits, reviews, and assessments by NASA Headquarters' "Office of Safety and Mission Assurance are supported as described in NPR 8705.6, Safety and Mission Assurance Audits, Reviews, and Assessments."

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### 15. Safety and health records

The following records will document safety and health inspections:

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## Part 2, Worksite analysis

- a. Center-level records – The Safety and Test Operations Division and the Clinical Services Branch shall keep records of annual inspections and track findings in the Hazard Abatement Tracking System.
- b. Organizational-level records – As a facility manager or line manager, keep records of your inspections and make sure the inspections are recorded in the Building Inspection Tracking System or equivalent system for your organization. Inspection records shall include:
  - 1. Date and time of the inspection.
  - 2. Areas or rooms inspected.
  - 3. A list of participants.
  - 4. Findings and actions taken. You may document the findings and actions in a tracking system or database.
- c. Organizational-level records – JSC Form 1240 that are posted in work areas to inform employees of hazards.

## 16. Measurement

JSC measures routine inspections by whether all work areas are inspected at least quarterly.

# Chapter 2.7

## Mishap and Incident Investigation

### 1. Applicability of this chapter

You are required to follow this chapter if you:

- a. Work at JSC or a JSC field site as a civil servant or contractor.
- b. Are a line manager, facility manager, contractor safety representative, director, or temporary official in charge of a mishap scene. Paragraph 20 of this chapter lists your responsibilities. Paragraph 20 of this chapter also lists the responsibilities of JSC's Center Director and the Director, Safety and Mission Assurance.
- c. Paragraph 21 of this chapter lists the responsibilities of the Safety and Test Operations Division, the Clinical Services Branch, the Security Branch, the Legal Office, the Public Affairs Office, the Information Systems Directorate, contracting officers, and technical representatives.

### 2. Description of Sub-element 2.7

JSC shall have a system to investigate mishaps and incidents that:

- a. Includes written procedures or guidance.
- b. Trains investigators.
- c. Produces written reports of findings.
- d. Tracks hazard elimination or controls to completion.
- e. Seeks the underlying causes of the mishap or event to prevent recurrence and avoids blaming the employee.
- f. Covers "close-call" incidents.
- g. Provides feedback and lessons learned to employees.

### 3. What this chapter excludes

This chapter covers how to report and investigate mishaps during JSC ground operations. It excludes the following:

- a. Emergency response to a mishap. You can find those requirements in Chapter 3.8.
- b. Liability, disciplinary action, or program direction.
- c. Response to spaceflight mission failures.

## *Reporting mishaps and close calls*

### 4. Actions if a mishap or close call occurs

If a mishap occurs in your area, you shall follow these steps (see also Attachment 2.7A, Appendix 2B for more information):

- a. Call your emergency number if the mishap is an emergency. Emergencies include:
  1. Mishaps that cause major injuries to one or more persons or major property damage.
  2. Mishaps that result in a condition that is immediately dangerous to life or health.
  3. Any unplanned or uncontrolled hazardous material spills or releases.
  4. Any unplanned fire or explosion.
  5. Mishaps that require prompt emergency response.

Remember, your emergency numbers are: x33333 at JSC and Sonny Carter Training Facility, x44444 at Ellington Field, 9-1-1 at any off-site location, and x5911 at White Sands Test Facility.

- b. Prevent further injury, damage, or environmental spill or release.
- c. Secure the mishap scene.
- d. Safeguard mishap evidence.
- e. Report the mishap or close call as described in paragraph 5 or 6 of this chapter.
- f. If you think the mishap could involve death, permanent disability, hospitalization of three or more persons, or damage greater than or equal to \$250,000, contact the Safety and Test Operations Division, the Safety and Mission Assurance Directorate, or the Center Director's Office immediately. NASA Headquarters and OSHA require JSC to report these mishaps immediately.
- g. Refer news media inquiries to the JSC Public Affairs Office.

The Director of Public Affairs is the only person allowed to coordinate releases of information to the news media.

### 5. Reporting close calls

Report close-call events where no injury, property damage, or environmental spill, release, noncompliance, or nonconformance occurred on JSC Form 1257 or the electronic form in the IRIS (when available). See Chapter 2.6 for more information; the investigation will follow this chapter. At JSC, a **close call** is an event that could have caused injury, property damage, or environmental release, spill, noncompliance, or nonconformance, but didn't. For example, someone falls from a ladder and is not injured, someone almost gets cut because a machine

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## Chapter 2.7, Mishap And Incident Investigation

guard is missing, or a spill almost occurs because a lid is missing from a waste containment drum. Close calls may result from hazards or unsafe acts. The Safety and Test Operations Division will assign an RAC for close call-reports as described in Chapter 3.2, “Hazard Elimination And Control,” paragraphs 3–5 of this Handbook. Report actual damage and environmental remediation costs under \$1000 on NASA Form 1627, even though NASA Headquarters defines it as a “close call.”

### 6. Reporting a mishap

A mishap is an event that causes unplanned or unexpected injury, property damage, or impact to the environment; e.g., death or injury to a test subject and irreparable damage or impact to natural or cultural resources are mishaps. Failure of a test object isn’t a mishap if you expected the failure to occur as a result of the test. The supervisor of the injured employee or the manager in charge of the area where damage or a hazardous material release or spill occurred is responsible for making sure the mishap is reported. However, anyone who witnesses the mishap may report it. You shall report all mishaps except those excluded by paragraph 1.2.2 of NPR 8621.1, “NASA Procedural Requirements for Mishap and Close Call Reporting, Investigating, and Recordkeeping.” To report a mishap:

- a. You shall fill out an initial written report within one working day on NASA Form 1627 (Part A only) and send it to the Safety and Test Operations Division or use the electronic form in IRIS (when available). For injuries or illnesses, sending an injured or ill employee to the JSC Clinic will automatically initiate an injury report (JSC Form 340). There is no need to fill out an initial report if the injured employee goes to the JSC Clinic. Then, complete any additional information requested by the Safety and Test Operations Division within one working day. This includes a NASA Form 1627, which is based on the JSC Form 340, until the electronic entry form in IRIS is available.
- b. You shall follow up with your investigation results within 2 weeks.
- c. You shall also report the mishap to your facility manager as soon as possible.
- d. You may report the mishap immediately to the Safety and Test Operations Division by telephone.
- e. You shall report at least the following mishaps (civil service or contractor) to your higher management and, ultimately, to the Center Director who notifies NASA Headquarters:
  1. Any Type A or B mishap involving damage, injury, or death. Immediately call the Center Director, Deputy Director, or Director. Safety and Mission Assurance. JSC shall notify Headquarters within 1 hour.
  2. Any injury or illness involving lost work days. Notify the Center Director to allow Headquarters notification within 24 hours.
  3. Any non-occupational fatality on site, such as one due to a heart attack. These cases won’t be recorded, but the Center Director shall notify Headquarters within 24 hours.

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## Part 2, Worksite analysis

4. Any serious injury or illness off the job. Reporting is voluntary on the part of the employee or family. These cases won't be recorded.
- f. You shall report mishaps that occur in foreign locations as described in paragraphs 7, 8, and 9 of this chapter.

### *Close calls and mishaps at international locations*

#### 7. Close calls and mishaps at international locations

You shall report:

- a. Any injury or occupational illness to JSC civil service or contractor personnel.
- b. Any damage to JSC equipment.
- c. Close calls where JSC personnel could have been injured or JSC equipment could have been damaged.

#### 8. How to report a close call or mishap at an international location

If a mishap occurs, follow the reporting process in this chapter as closely as your situation will allow. Call the JSC Safety and Test Operations Division at (281) 483-2084 during normal JSC duty hours (central time) or the JSC Emergency Operations Center at (281) 483-4658 outside of normal JSC duty hours to report the mishap. You shall:

- a. Report the mishap to JSC via telephone within 1 hour if it involves death, serious injury, or property damage exceeding \$250,000.
- b. Report the mishap via telephone within 24 hours if it involves other injuries or property damage less than \$250,000, or if it's a close call.
- c. Report the mishap or close call to your Directorate management as soon as possible.
- d. Fax a mishap report (NASA Form 1627) to the Safety and Test Operations Division or the electronic form in IRIS within 24 hours at (281) 244-0983 for mishaps that involve injury or property damage.
- e. Fax a close-call report (JSC Form 1257) to the Safety and Test Operations Division or the electronic form in IRIS within 24 hours at (281) 244-0983 for close calls.

#### 9. What to do if you are injured at work while on foreign travel

You shall report to the JSC Clinic on your first business day after returning to work at JSC. This will allow the clinic personnel to make sure you have recovered or will recover, and to update your medical records.

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## Chapter 2.7, Mishap And Incident Investigation

### 10. Investigating mishaps in foreign countries

Your organization and the Safety and Test Operations Division will make sure the mishap is investigated under NASA requirements and international agreements.

### *Investigating mishaps*

### 11. How to investigate a mishap as an individual or member of a small team

All mishaps require an investigation. The Environmental Office takes the lead for mishap investigations that are strictly environmental, and will help line management with other investigations that involve environmental issues. Line managers or facility managers may delegate an investigation to employees or employee teams. The investigation results, to include action plan or rationale why no action is necessary, are due within 2 weeks of the mishap unless you request an extension through the Safety and Test Operations Division. To investigate a mishap you shall:

- a. Start your investigation as soon as all emergencies are under control. You may ask the Safety and Test Operations Division for help. A Safety and Test Operations Division representative may already be on the way to the scene. Providing medical help to injured persons and preventing further injury or damage take priority over the steps listed below. After a mishap, you shall first:
  1. Identify potential witnesses and get statements from them.
  2. Secure the mishap scene and protect it from being disturbed.
  3. Safeguard evidence such as samples and photographs.
  4. Secure all records such as checklists, videos, and electronic data.

JSC's Center Director may appoint a mishap investigation board to investigate your mishap. If he or she appoints a board, you shall stop your investigation, keep the mishap scene and evidence secure, and cooperate with the board.

If you think a mishap investigation board should investigate your mishap, contact the Safety and Test Operations Division.

- b. Refer any news media personnel that ask about the mishap to the Public Affairs Office.

The Director of Public Affairs is the only person who is allowed to coordinate releases of mishap information to the news media.

- c. Consult any experts you need to sample the mishap scene or analyze the data.
- d. Interview witnesses. You shall keep witness statements confidential.
- e. Examine all evidence and analyze all mishap data to the appropriate investigation level described in paragraph 12 below. You may also use the current version of the checklists in Appendix 6 of JSC 29406, "JSC Mishap Investigation Board Handbook" as guidelines.

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## Part 2, Worksite analysis

- f. Document the results of your investigation and action plan or actions taken. Submit the results to the Safety and Test Operations Division as follows:
  - 1. Provide the required products for the mishap type listed in figure 5 and paragraph 1.7 of NPR 8621.1 “NASA Procedural Requirements for Mishap and Close Call Reporting, Investigating, and Recordkeeping.”
  - 2. Document the results of mishap investigations, where there is an injury or any damage, on an electronic investigation form you receive via electronic mail, NASA Form 1627, or in IRIS. Include any additional documentation required in NPR 8621.1.
  - 3. Document the results of a close-call investigation (no injury or damage) on the close-call response form provided when the investigation is assigned or in IRIS.
- g. The investigator’s supervisor shall review and concur with the results of mishap investigations. The close-call reporter will have an opportunity to review and comment on the results of close-call investigations.
- h. Have your facility manager concur on the proposed action if the mishap involved the building or hazardous materials.
- i. Document lessons learned as described in paragraph 16 of this chapter.
- j. Work the action plan and track to closure as described in paragraph 13 of this chapter.

Don’t use your investigation to find fault, determine disciplinary action, or defend JSC from lawsuits. Your investigation is only to prevent the mishap from happening again.

## 12. Investigation levels for mishaps and close calls

When you investigate a mishap or close call, you shall find the cause(s) of the mishap or close call and decide what actions you will take to eliminate or control the hazard. The basic process for investigating Type C or D and “Close Call” mishaps is in Attachment 2.7B, Appendix 2B. See Attachment 2.7D of Appendix 2B for more details on OSHA and NASA mishap categories. Contact the Environmental Office for mishaps that are strictly environmental. Take the following steps to investigate a mishap or close call:

- a. For Type C mishaps – Lost time injuries (including restricted duty injuries), damage greater than or equal to \$250,000 and less than \$2500,000:
  - 1. Do a full root cause analysis using an established root cause method. The cause may be simple, but try to look beyond the obvious. Perhaps the hazard was caused by some deficiency in the management system. Perhaps it was caused by human error, which resulted from deficiency in the management system. As a minimum, you shall use the Mishap Investigation Checklist in Attachment 2.7C, Appendix 2B. You may use other root cause methods and provide documentation in a standard Microsoft Office or PDF format.

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## Chapter 2.7, Mishap And Incident Investigation

2. Evaluate the root causes and determine which ones you need to fix to prevent injuries or future hazards.
  3. Develop an action plan to change, control, or prevent those root causes from causing injuries or future hazards. The plan may involve one item or many. Remember to turn in work requests, if necessary. If your investigation shows that no action is necessary, you shall provide rationale.
  4. Provide the products required for Type C mishaps listed in figure 5 and paragraph 1.7 of NPR 8621.1 “NASA Procedural Requirements for Mishap and Close Call Reporting, Investigating, and Recordkeeping,” in a commonly available electronic format such as PDF or Microsoft Office software.
- b. For other injuries and damage cases, RAC 1 and 2 close calls, and RAC 3 and 4 close calls that involve an event (as opposed to merely reporting a hazard):
1. Determine the root cause(s). Avoid blaming the employee without looking into the cause. The obvious cause may be that the employee didn’t follow procedures. However, this may have happened because there were no procedures or because management didn’t train the employee in the procedures. As a minimum, you shall use the Mishap Investigation Checklist in Attachment 2.7C, Appendix 2B. You may use other root cause methods and provide documentation in a standard Microsoft Office or PDF format.
  2. Develop an action plan to address the causes. Your action plan may involve one item or many. Remember to turn in work requests, if necessary. If your investigation shows that no action is necessary, you shall provide rationale.
  3. Provide the products required for Type D mishaps and close calls listed in figure 5 and paragraph 1.7 of NPR 8621.1, “NASA Procedural Requirements for Mishap -and Close Call Reporting, Investigating, and Recordkeeping,” in a commonly available electronic format such as PDF or Microsoft Office software.

### 13. Taking action after an investigation

The following rules apply to action plans developed during mishap and close-call investigation:

- a. If you assign actions to other organizations such as the Center Operations Directorate to modify the building or the Clinical Services Branch to sample the work area, contact those organizations ahead of time. If they don’t refuse the action within 5 working days, they have accepted the action. It is their responsibility to complete the actions.
- b. If you or another organization wants to change any estimated completion dates for any actions, you shall get approval from your director.
- c. The Safety and Test Operations Division will track actions in IRIS until they are completed and verified.
- d. Verification of completed action will be as follows:

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## Part 2, Worksite analysis

1. For lost time mishaps (including restricted duty cases) or mishaps involving damage greater than or equal to \$250,000 and less than \$250,000, the Facility Manager shall first verify completion and the Safety and Test Operations will follow up with an independent verification.
2. For less serious mishaps than those mentioned in subparagraph d.1 above and RAC 3 or 4 close calls, the Facility Manager verification will be sufficient to close the mishap or close call. The Safety and Test Operations Division may also follow up with an independent verification.

### 14. Mishap investigation boards

Mishap investigation boards are a formal method for investigating serious or potentially serious mishaps or close calls. Mishap investigation boards shall follow JSC 29406 and are required for the following mishaps:

- a. Any mishap involving death or damage greater than or equal to \$12,000,000. Normally, NASA Headquarters will appoint the board for a Type A mishap, but may delegate it to the JSC Center Director.
- b. Any mishap involving permanent disability, hospitalization of three or more persons, or damage greater than or equal to \$250,000 and less than \$12,000,000. JSC's Center Director will appoint the board.
- c. Any other lower level mishap or close call with a high potential for death or serious injury or damage or with a high visibility as determined by the Safety and Mission Assurance Directorate or Center management. Organizational Directors also have the option to appoint Directorate-level boards for mishaps they consider significant. Candidates for mishap investigation boards include:
  1. Mishaps entailing a high potential for death, serious injury, or damage and high-visibility mishaps.
  2. Mishaps causing significant schedule delays.
  3. Mission or test failures that significantly reduce the potential for successful achievement of mission or test objectives, or affect other government organizations or the general public.

### 15. Contractor mishaps and mishaps investigated by outside agencies

Contractors will investigate mishaps (including environmental mishaps) that involve only contractor personnel or equipment at an off-site location as described in their contracts and in paragraph 1.10.5 of NPR 8621.1. Contractor mishaps involving injury to NASA personnel or property shall be investigated as outlined in this chapter. JSC may accept investigations by outside agencies, such as OSHA or law enforcement agencies, as described in paragraph 1.10 of NPR 8621.1. JSC personnel shall support these investigations as needed.

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## *Other requirements and responsibilities*

### **16. Sharing lessons learned from mishaps or close calls**

When you finish your investigation, decide whether you have any lessons learned to share with other organizations that would prevent them from having a similar safety, health, or environmental mishap.

- a. If you have any lessons learned, you shall attach them to your final mishap or close-call report when you send the report to the Safety and Test Operations Division. Enter the lessons learned into the NASA Lessons Learned system at <http://llis.gsfc.nasa.gov>. See paragraph 7.6 of NPR 8621.1.
- b. The Safety and Test Operations Division shares lessons learned with:
  1. JSC employees and organizations that would benefit through means such as alerts, announcements, or special reports.
  2. Organizations outside JSC that would benefit through the Government Industry Data Exchange Program, product safety bulletins, or other means.

### **17. Notification of mishaps**

If a mishap occurs, the Safety and Mission Assurance Directorate shall:

- a. Notify NASA Headquarters by phone within 1 hour of any Type A or Type B mishaps and other high-visibility mishaps, mission failures, and close calls using NASA Form 1627A or equivalent in IRIS. Notify the Office of Safety and Mission Assurance during normal duty hours and the NASA Headquarters Emergency Center, (202) 358-1616, during non-duty hours.
- b. Notify the nearest OSHA office within 8 hours of any mishap that causes a death or hospitalization of three or more persons. This includes mishaps that cause death or hospitalization of three or more persons within 30 days of the mishap. After notifying OSHA, notify NASA Headquarters, Office of Safety and Mission Assurance of the OSHA report. The report shall contain the following:
  1. What happened, the date and time it happened, and where it happened.
  2. Who suffered a death, injury, or illness and, by name, who else was involved.
  3. How serious the injuries or illnesses are.
  4. What actions JSC took after the mishap.
- c. Notify the Office of Safety and Mission Assurance during normal duty hours of mishaps and close calls that do not require immediate reporting but, in the judgment of the Safety and Test Operations Division, may receive high visibility from the public or the press, or have recurrence control implications beyond the local Center.

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## Part 2, Worksite analysis

- d. Decide, through the Center Director, if any other organization such as the EPA, Federal Emergency Management Agency (FEMA), NASA Headquarters, or local authorities should be notified under JSC's emergency preparedness plans.
- e. Follow JPD 1712.1 "Management Notification Policy for Use in the Event of Serious Illness, Injury, or Death," current version.
- f. Send a summary of the mishap report for any mishap described in subparagraph a above to OSHA's Office of Federal Programs through NASA Headquarters.
- g. Provide the NASA Headquarters Office of Safety and Mission Assurance with major mishap reports as required by NPR 8621.1 "NASA Procedural Requirements for Mishap and Close Call Reporting, Investigating, and Recordkeeping."
- h. Provide an electronic report to NASA Headquarters for reportable mishaps within 1 working day of the mishap and updates, including closure, via IRIS, within 1 week of receiving the data.

## 18. Training for mishap investigators

Mishap investigators shall have the following training:

- a. "Introduction to Mishap Investigation" on SATERN (Site for On-Line Learning and Resources), course number SMA-00x-05.
- b. "Root Cause Analysis" through the JSC Safety Learning Center or the NASA Safety Training Center.

## 19. For more information on reporting and investigating close calls and mishaps

You can find more information on reporting and investigating close calls and mishaps in these documents:

- a. NPR 8715.1, "NASA Safety and Health Handbook, Occupational Safety and Health Programs."
- b. Letter UO, dated August 6, 1993, "Federal Agency Recordkeeping" from the Director of Occupational Health and Aerospace Medicine Division, NASA Headquarters.
- c. JSC 05900, "JSC Emergency Preparedness Plan" including all annexes.
- d. JPD 1382.1, "Release of Information to News Media," current version.

## 20. Individual responsibilities for reporting and investigating mishaps

- a. **Line managers** are responsible for:
  - 1. Making sure close calls and mishaps in your area are reported as described in paragraphs 5 and 6 of this chapter.

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## Chapter 2.7, Mishap And Incident Investigation

2. Investigating all Type C mishaps, incidents, and first-aid injuries as described in paragraph 12 of this chapter.
  3. Taking necessary actions to correct hazards discovered during your investigation as described in paragraph 13 of this chapter. This includes temporary measures to protect your employees and the environment while you wait on building or equipment changes. Improve on your action periodically.
  4. Supporting mishap investigation boards as necessary.
  5. Always reminding your employees that reporting close calls and mishaps is necessary. Reward those who promptly report close calls and mishaps, and reprimand those who don't.
  6. Monitoring the recovery of any employee with a lost time injury. Arrange for that employee to return to work on light or restricted duty as soon as possible.
  7. If the mishap results in a death or personal injury requiring immediate hospitalization or in damage estimated to exceed \$10,000 to Government or private property, refer to NPR 3792.1, "NASA Plan for a Drug-Free Workplace," to determine whether additional action outside the safety mishap reporting and investigating process should be taken.
- b. As a ***contractor safety representative***, you are responsible for helping contractor or NASA management with close-call and mishap reporting and investigation as necessary.
- c. As a ***facility manager***, your knowledge of your facility is important to a mishap investigation. You are responsible for:
1. Responding to close calls and mishaps that occur in your facility.
  2. Making sure close calls and mishaps that occur in your facility are reported and investigated.
  3. Investigating close calls. Support mishap investigations as necessary.
  4. Making sure that employees in your facility know about action plans and lessons learned.
- d. An ***Organizational Director*** at JSC is responsible for:
1. Developing processes for reporting and investigating close calls and mishaps that occur in your Directorate.
  2. Reviewing open close-call or mishap reports in your Directorate and making sure that they are closed in a timely manner.
  3. Providing services from your Directorate that other JSC organizations need to correct hazards found during investigations such as testing, evaluating data, modifying buildings or equipment, or sampling work areas.
  4. Being aware of mishaps in your Directorate and notifying the Deputy Center Director of lost time mishaps.

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- e. If JSC's Center Director appoints you *temporary official in charge of a mishap scene*, you are responsible for:
  - 1. Overseeing the mishap scene until a mishap investigator or board takes over.
  - 2. Keeping the Director, Safety and Mission Assurance, or Center Director informed of your status.
  - 3. Cooperating with the incident commander at the scene of a hazardous material spill. The incident commander is in charge of the scene.
- f. The *JSC Center Director* is responsible for:
  - 1. Being the chief spokesperson for all JSC mishaps with local, state, and federal authorities and the news media through the Public Affairs Office.
  - 2. Supporting investigations of NASA mishaps by other federal agencies that have authority to investigate NASA mishaps (such as the National Transportation Safety Board) for aircraft mishaps and the U. S. Department of Labor for occupational mishaps). Support investigations of mishaps experienced by other federal agencies, foreign governments, and private industry per agreements.
  - 3. Appointing a temporary official in charge of a mishap scene for major mishaps if necessary. The temporary official in charge will usually be: for JSC mishaps, the Safety and Mission Assurance Director; for aircraft mishaps, the aviation safety officer of the Flight Crew Operations Directorate; or, for mishaps at JSC field sites, the chief of the local quality assurance, reliability, and safety office.
  - 4. Making sure the temporary official in charge of a mishap scene gets necessary support until the mishap investigator or board takes over.
- g. The *Director, Safety and Mission Assurance*, is responsible for:
  - 1. Notifying JSC senior management and other organizations of all immediately reportable mishaps as described in paragraph 17 of this chapter.
  - 2. Recommending to JSC's Center Director how mishaps should be categorized (such as Type A or B) and investigated.
  - 3. Notifying the Office of the Inspector General (OIG) and the Office of the Chief Counsel immediately if it is reasonably suspected that a mishap resulted from criminal activity so that the OIG and chief counsel can appropriately coordinate their activities with the responsible workplace official.
  - 4. Review mishap investigation board reports from other centers to determine applicability to JSC. Recommend actions as appropriate.
- h. *Contracting Officers and their technical representatives* are responsible for:
  - 1. Making sure that JSC contractors understand and follow NASA and JSC contract requirements for reporting and investigating close calls and mishaps.

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## Chapter 2.7, Mishap And Incident Investigation

2. Including applicable mishap and close-call reporting and investigating procedures detailed in the NASA Federal Acquisitions Regulations Supplement into contracts covering NASA programs and operations.

### 21. Organizational responsibilities for reporting and investigating mishaps

- a. The **Safety and Test Operations Division** is responsible for:
  1. Providing JSC with a list of personnel trained in mishap investigations.
  2. Keeping records of close-call and mishap reports and investigations and tracking all items to completion.
  3. Coordinating with the Environmental Office on environmental mishap and close-call investigations.
  4. Helping with close-call and mishap investigations and actions as necessary.
  5. Reviewing and approving close-call and mishap reports and action plans. Evaluate reports for possible lessons learned.
  6. Verifying that actions are completed.
- b. The **Environmental Office** is responsible for:
  1. Helping the Safety and Test Operations Division with environmental mishap and close-call investigations.
  2. Helping the Safety and Test Operations Division to review and approve environmental mishap and close-call reports and action plans
  3. Evaluating close-call and mishap reports for possible environmental lessons learned.
- c. The **JSC Medical Clinic** (Clinical Services Branch) is responsible for:
  1. Filling out JSC Form 340 when an employee has an injury or illness on the job. Send copies to the Safety and Test Operations Division and the injured employee's supervisor or company.
  2. Informing the employee's supervisor and the Safety and Test Operations Division immediately of a fatality or a suspected disabling injury or illness
  3. Providing any necessary occupational health and industrial hygiene support required by other JSC organizations to fulfill any of the responsibilities of this chapter.
  4. Providing medical or pathological information required to fulfill the requirements of this chapter under the Privacy Act of 1974.
- d. The **Security Branch** is responsible for:
  1. Making sure that mishap scenes are secured.
  2. Making sure that evidence and important information are preserved for the investigation.

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3. Investigating motor vehicle accidents.
- e. The **Legal Office** is responsible for:
  1. Having ground rules to protect the privileged status of witness statements, witness testimony, or other matters related to a mishap.
  2. Reviewing mishap information or reports before they are released from JSC control to make sure the facts are correct and can be released.
- f. The **Public Affairs Office** is responsible for:
  1. Preparing releases of any mishap information to the news media or other organizations outside JSC under JPD 1382.1, "Release of Information to News Media," current version.
  2. Having the JSC Legal Office and anyone else connected with the mishap, such as the mishap investigator or board chairperson, review information to make sure the facts are correct and can be released.
  3. Protecting the privileged status of witness statements, witness testimony, and other matters related to a mishap under Legal Office ground rules.
  4. Following procedures for public announcements by NASA found in agreements with other agencies or contractors when releasing mishap information.
  5. Coordinating information releases as described in paragraph 3.9 of NPR 8621.1.
- g. The **Information Resources Directorate** is responsible for providing photographic and other information services on a priority basis when needed by mishap investigations.

## 22. Safety and health records

The following records document mishap and incident investigation:

- a. Center-level – The Safety and Test Operations Division shall maintain:
  1. Copies of NASA Form 1627.
  2. A tracking database to track mishap data, investigation, and closeout.
  3. Mishap information and submit to IRIS.
  4. Copies of JSC mishap investigation board reports and supporting material such as procedures, minutes, tape recordings, etc.
  5. A log of occupational injuries and illnesses, OSHA Form 300 as described in Appendix 1.
  6. The Annual Summary of Federal Occupational Injuries and Illnesses on OSHA Form 300 as described in Appendix 1.

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## Chapter 2.7, Mishap And Incident Investigation

- b. Organizational-level – As a line manager, you are encouraged to keep records on mishaps in your work areas to include copies of completed NASA Form 1627 and any supporting documentation.

### 23. Measurement

The following factors measure mishap and incident investigation:

- a. Timeliness of mishap reporting.
- b. Timeliness of investigation and follow up.



## Attachment 2.7D OSHA and NASA mishap categories

The following table correlates OSHA and NASA definitions.

OSHA Category	NASA category
Death or hospitalization of three or more persons for more than observation is immediately reportable to OSHA within 8 hours.	<i>Type A Mishap</i> (one or more of the following) Death A permanent total disability Hospitalization of three or more persons within 30 workdays of the mishap Damage greater than or equal to \$42M
Lost workday case involving days away from work (LW-DA).	<i>Type B Mishap</i> (one or more of the following) Permanent partial disability Hospitalization of one or two persons within 30 workdays of the mishap Damage greater than or equal to \$250,000 and less than \$42M
Days away, restricted, transfer (DART) – Cases that involve <i>days away from work</i> or <i>days of restricted work activity</i> , transfer to another job or any combination of the three.	<i>Type C Mishap</i> (one or more of the following) Lost workday case Restricted duty Transfer to another job Damage greater than or equal to \$250,000 and less than \$250,000
LW-DA – Workdays (consecutive or not) on which the employee would have worked but could not because of an occupational injury or illness, not including the day of the injury.	
Lost workday case involving restricted duty (restricted work activity) (LW-RD) – Workdays (consecutive or not; not including the day of the injury) on which, because of an injury or illness, the employee:	
<ul style="list-style-type: none"> <li>(1) Was temporarily assigned to another job; or</li> <li>(2) Worked at a permanent job less than full time; or</li> <li>(3) Worked at a permanently assigned job but could not do all duties normally connected with that job.</li> </ul>	
No corresponding OSHA category	<i>Mission or Test Failure</i> Prevents accomplishing primary mission or test objectives
No corresponding OSHA category	<i>Environmental Impact</i> Results in an unplanned and uncontrolled hazardous material spill or release or an environmental violation or fine
Medical Treatment Case as defined by OSHA	<i>Type D</i> (one or both of the following) Injury or illness without lost time that requires “medical treatment” as defined by OSHA Damage greater than or equal to \$1,000 and less than \$250,000
First-Aid Case as defined by OSHA	<i>First-Aid Case</i> Injury or illness that requires only first-aid treatment
Not OSHA-Recordable	
No corresponding OSHA category	<i>Close Call</i> (one or both of the following) An event or a condition that could have resulted in an injury, an illness, or a significant interruption of work or environmental spill, release, noncompliance, or nonconformance, but did not. Damage less than \$1,000

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Verify this is the correct version before you use it by checking the online version.



## Chapter 5.2

# Office and General Work Area Safety

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### ***This could be you . . .***

*Two employees were burned by candles on their desks.*

*One employee was hurt when an over-loaded bookcase fell.*

*An employee slipped and fell on a freshly waxed floor, resulting in a lost-time case.*

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### **1. Applicability of this chapter**

You are required to follow this chapter if you work at JSC or a JSC field site.

### **2. What this chapter covers**

This chapter covers the basic controls for common hazards and safe work practices in offices and general work areas. The requirements and recommendations in this chapter stem from JSC's mishap and close call data as well as federal regulations.

### **3. What you need to do to be safe in your office**

To increase your safety in the office or other work area, you shall follow the requirements in this chapter and think about consequences before taking action.

### **4. Doors, aisles, and hallways**

Follow these rules to stay safe in doors, aisles, and hallways:

- a. Keep required fire doors closed at all times. You may leave fire doors open if they have automatic releases and self-closing hardware, but don't block them with anything that would interfere with their operation.
- b. If you see yellow stripes on the floor in front of a door and an OPEN DOOR SLOWLY sign, open the door with care. It opens into the flow of traffic, and you could hit someone.
- c. Don't store anything in aisles and hallways. Keep aisles and passageways clear and in good repair. Remove or mark anything that blocks or sticks into an aisle or passageway. Maintain the minimum widths for exit routes shown in the diagram in Attachment 5.1A, Appendix 5. Also, see Chapter 5.1, paragraphs 9 and 13. These are the minimum acceptable widths based on the National Fire Protection Association Standard 101, "Life Safety Code." The JSC Furniture Office may require wider exit widths to allow them to move furniture easily.

## Part 5, Safety and health practices for everyone

- d. Cover sharp or pointed objects that block or stick into an aisle or a passageway to prevent someone from being cut or stabbed.
- e. If you spill something or see a spill, stop what you are doing and clean it up. You will prevent JSC's most common mishap: slips, trips, and falls.
- f. Place broken glass in a puncture-proof container or wrap it in paper and label it "Glass" before putting it in a trash can.
- g. Make sure there is enough safe clearance when you use mechanical handling equipment such as pallet jacks or forklifts.

### 5. Walking and working surfaces

Follow these practices in your work area and building:

- a. Keep floors and working surfaces as clean and dry as possible.
- b. Maintain good drainage in areas with wet processes such as washing areas. Provide dry places to stand with false floors, platforms, mats, or other means.
- c. Protect floor openings, open pits, tanks, vats, or ditches with covers or guardrails. If you can't protect them yourself, report them to your supervisor. Make sure others don't fall into any of these openings by using signs or cones or posting a guard.
- d. Keep outside walking and working surfaces free of ice, snow, mud, grease, or other stuff that may make them unsafe. You may use sand, cinders, or other approved material to reduce slip hazards. Report any areas you can't clear, cover, or block off to Work Control, x32038.

### 6. Telephones and electrical equipment

Electrical equipment and telephones cause many office mishaps. Here's what to do to stay safe:

- a. Use desks, tables, and other equipment to cover all floor telephone jacks and electrical outlets (commonly known as tombstones) by desks, tables, and other equipment, ensuring your feet are clear of them.
- b. Don't place telephone or electrical cords across aisles unless you cover the cords with rubber channels designed for this purpose.
- c. Use only personal equipment that is listed by Underwriters Laboratories (UL, Factory Mutual [FM]), or other recognized testing laboratories and that is in good working condition, such as coffee makers, radios, or lamps at work.
- d. You may use UL-rated forced-air space heaters only if they have a tip-over cutoff switch. Never use a radiant space heater. NOTE: The Center Operations Directorate may restrict the use of space heaters for other reasons, such as energy conservation. When space heaters are allowed, they shall follow the requirements above.

## Chapter 5.2, Office and General Work Area Safety

- e. Occasionally check all of your electrical cords, plugs, and outlets for damage or frayed points. Replace any that show signs of excessive wear.

### 7. Power strips and extension cords

Don't connect power strips or extension cords together (that is, "daisy chain" them) since you risk overloading the circuit. You may only use extension cords under certain circumstances. Follow the rules below:

- a. You may use extension cords only under the following circumstances:
  - 1. Temporary work such as buffing floors, remodeling, or construction.
  - 2. To provide power for temporary decorations or special events. This is limited to 90 days or less.
  - 3. Development projects or experiments. You shall remove the extension cords at the end of the project.
- b. Power strips and extension cords shall meet the following:
  - 1. Use only UL-listed, double-insulated cords or power strips that are rated for the current they will carry.
  - 2. Never run the cords through walls or ceilings.
  - 3. Try to avoid running cords behind furniture such as filing cabinets or bookcases where they could be pinched or damaged. If this is necessary, leave a space behind the furniture for the cord.

### 8. Computer workstations

Computers cause many small injuries that get worse if not corrected right away. Here's what to do:

- a. Your furniture shall be ergonomically designed so that you have no discomfort when working at your computer. See Chapter 5.5, "Ergonomics," for more ergonomic recommendations. Here are some general ones:
  - 1. Place your keyboard and monitor directly in front of you.
  - 2. Adjust your chair to fit you and make sure it has firm back support.
  - 3. Use soft wrist rests at the keyboard and mouse.
  - 4. Place your monitor screen so you see no glare.
  - 5. ~~Make~~ Secure your overhead hutch is secured to the desk or table it sits on. Contact Logistics Work Control for help.
- b. To clean the monitor, spray cleaning solution onto a cloth, then wipe the monitor. JSC has had several small fires and electrical shorts from cleaners sprayed directly onto screens.

## Part 5, Safety and health practices for everyone

### 9. Office supplies and equipment

Knowing what office supplies are in your office and how to store them properly is key in this area. Follow these rules:

- a. Don't store office supplies, equipment, or anything else in any building's mechanical rooms. Many fires begin in mechanical rooms, so it's best never to store anything, especially anything that burns, in these areas.
- b. Store all office supplies in cabinets or on shelves in areas designed for storage.
- c. Keep only small quantities of flammable or combustible fluids, such as cleaning supplies or printer toners and inks. Store quantities greater than 5 gallons in fireproof cabinets or bulk storage areas.
- d. Maintain material safety data sheets on all spray paints and any hazardous office supplies (for example, liquid paper, copier toner) used in greater than home-use quantities. You can download Material Safety Data Sheets from the Health Home Page at <http://ks.jsc.nasa.gov/haz/msds/msdssearchform.cfm>. Direct questions about hazardous materials to the Clinical Services Branch at (281) 483-7512. See Part 9, "Safety and health practices for hazardous materials," of this Handbook for more information on hazardous materials.
- e. Keep combustible materials such as wall-mounted combustible materials, paper, tapes, and wood to a minimum.
- f. Don't have open flames such as candles in your office; they could burn you or start a fire.
- g. Don't hang anything from the ceiling. It could stress the ceiling or dislodge a ceiling tile.
- h. Don't use halogen lamps. The bulbs get extremely hot and could easily start a fire.

### 10. Office furniture

Defective or improperly placed furniture has injured some people at JSC. Follow these prevention guidelines:

- a. Periodically inspect your office furniture for worn, cracked, or loose parts.
- b. Don't put anything that could fall and injure you on top of bookcases, storage cabinets, and large equipment. Small personal items such as pictures or plants, if stable, are allowed.
- c. Secure books on top of furniture with bookends.
- d. Keep at least an 18-inch clearance between the deflectors of sprinkler heads and materials or furniture below. This doesn't apply to cabinets or shelving placed against a wall unless the shelving is directly under a sprinkler head. Shelves or equipment against a wall or mounted to a wall may penetrate the 18-inch clearance unless they are directly below a sprinkler head. In that case, the 18-inch clearance applies.



## Chapter 5.2, Office and General Work Area Safety

- e. Leave adequate space for proper activation and maintenance around heat or smoke detectors.
- f. For stackable bookshelves:

<i>If your bookshelves are located . . .</i>	<i>Then you may stack . . .</i>
Against a wall, furniture, or secured panel	Four shelves
Free-standing	Three shelves

- g. Multi-shelf, single-unit (non-stackable) bookcases are acceptable if they are against a wall, furniture, or secured panel.
- h. Remember that while new file cabinets generally have satisfactory safety features, older units, which are prevalent on site, do not. Follow these practices for file cabinets:
  - 1. To prevent file cabinets from tipping over, secure them to the floor if possible or, at a minimum, weigh them down at the lowest drawer.
  - 2. Open only one drawer at a time, and be certain to latch closed drawers that are not in use. If more than one drawer is open, the unit can become unstable and tip.
  - 3. Never switch drawers between cabinets. This can render safety devices, including drawer stops and latches, inactive if they don't match between the cabinet and drawer. The drawer may seem to fit, but it may not be properly secured and could potentially cause injury.

### 11. If you have a disability

Contact the Equal Opportunity Programs Office at (281) 483-0607. JSC makes every effort to accommodate employees according to the Americans with Disabilities Act.

### 12. If you visit other work areas

If you visit other work areas, you shall ask the occupants of that area what the safety rules are and follow them. For example, if you visit a warehouse, know and follow the requirements in Chapter 6.3, "Warehouse Safety and Health," of this Handbook. See the table of contents of this Handbook for a complete listing of safety and health rules for various areas and operations.

### 13. Jewelry in other work areas

If you do any maintenance or troubleshooting on any electrical or mechanical system or subsystem, you shall first remove all rings, watches, jewelry, or other metallic objects that are electrical conductors or that could be caught on sharp objects or corners.

**Part 5, Safety and health practices for everyone**

**14. Manual material handling**

Attachment 5.2A, Appendix 5B, contains guidelines for safe manual lifting and material handling.

# Chapter 5.8

## Hazardous operations: safe practices and certification

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### *This could be you . . .*

*An employee was working on a water tower base without using the buddy system or checking the air quality and was overcome due to an oxygen deficiency.*

*Another employee was dispensing a chemical through a liquid sprayer, which he had done numerous times before based on his training. Unfortunately, he failed to read the current MSDS, which indicate that, there had been a change in the chemical make-up; this resulted in an allergic reaction to the new chemical composition.*

*Contaminated solder was used in a space shuttle component because there were no requirements to certify solder technicians.*

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### 1. Applicability of this chapter

You are required to follow this chapter if you do or oversee any hazardous operations at JSC or JSC field sites. Paragraph 19 lists the responsibilities of supervisors, line managers, safety representatives, certified confined space supervisors, contracting officers, the Safety and Test Operations Division, the Clinical Services Branch, and the Employee Development Branch.

### 2. Hazardous operations

A hazardous operation is a job that involves hazardous materials, conditions, or equipment that could result in injury or property damage if you don't follow special precautions.

### *Requirements for hazardous operations*

### 3. Requirements for any hazardous operation

If you do or oversee hazardous operations, you shall:

- a. Decide which category—I, II, III, or IV—your operation belongs in and follow the appropriate certification requirements. See paragraphs 4, 5, 6, and 7 of this chapter.
- b. Inform your organizational director of the risks involved in any new or non-routine hazardous operation with the potential for death, serious injury, or loss of critical high-dollar-value hardware before you start.
- c. Make sure, as a supervisor, that everyone follows any requirements that apply to the

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## Part 5, Safety and health practices for everyone

operation or that are listed on the permit.

- d. Use the “buddy system” with at least one standby person in one of these ways:
  1. One of you does the job and the other watches from the immediate area of the job to make sure the “worker” is safe.
  2. Two of you do the job and you keep in constant contact with a standby person electronically, mechanically, or visually. The standby person shall remain in the immediate area where you are working.
  3. Two of you do the job and you keep in contact with a standby person by coded lifeline signals even though you may be out of sight of the standby person. The responsible safety representative will decide how many worker and standby person combinations there need to be.
- e. Take extra care, as a supervisor, to recognize and respond to dangerous situations when:
  1. Your employees work in hazardous areas they aren’t normally assigned to.
  2. Your employees are working near public access areas.

### 4. Requirements for Category I hazardous operations

Category I jobs involve operations that are likely to either cause death or serious injury or high-dollar property damage for JSC. Category I jobs include, but are not limited to, those listed in the table on the following page. Chapter numbers given are for chapters in this Handbook. For Category I jobs, you shall have at least the following:

- a. Classroom or on-the-job training or both for initial certification, and then as needed.
- b. Written examination ~~or experience review by line management~~. Many chapters in this Handbook and other requirements list training requirements for certain operations.
- c. Annual retraining that will include review of emergency response and first-aid procedures.
- d. Recertification as required or as necessary.
- e. Permits (hazardous operations permit (HOP), hot work permit (HWP), or confined space entry permit (CSE)) or physiological training if necessary.
- f. Physical examination if required by the Clinical Services Branch. See Chapter 3.6, “Occupational Healthcare Program,” of this Handbook for more details on physical examinations. Physiological training may also be required.

## Chapter 5.8, Hazardous operations: safe practices and certification

<i>For these personnel or operations . . .</i>	<i>Permit req'd . . .</i>	<i>Physio trng req'd?</i>	<i>Med. exam req'd?</i>	<i>Follow requirements in . . .</i>
Working on an aircrew	none	yes	yes	n/a
Operating aircraft engine test cells (T-38 aircraft sound suppression facility)	none	no	yes	n/a
Operating a crane	HOP, for heavy lifts	no	some, see Chapter 3.6	Chapter 8.5
Handling explosives or pyrotechnics (ordnance category)	HOP	no	no	Chapter 9.5
Handling propellants	HOP	no	yes	Chapter 9.5
Rescue personnel	none	yes	yes	n/a
SCAPE operators	none	no	yes	n/a
Scuba diving and operating neutral buoyancy tanks	HOP	no	yes	Chapter 6.6
Handling pesticides, insecticides, or herbicides	HOP	no	yes	Chapter 9.3
Test directors and subjects ( <del>including flights with and without human subjects</del> )	none	yes*	yes	Chapter 6.9
Test conductors and engineers	none	yes*	yes	Chapter 6.9
Washing windows on multistoried buildings	none	no	no	Chapter 8.7
Handling lithium cells or batteries	none	no	no	Chapter 6.1
Working in confined spaces	CSE	no	no	Chapter 6.10

\*Required for human occupied hyperbaric and hypobaric activities only.

### 5. Requirements for Category II hazardous operations

Category II jobs involve operations that, if not done correctly, could create a severe hazard to the operator or user, other personnel, or property. The requirements for Category II jobs are similar to those for Category I jobs. You may reduce the levels of physical examination, training, and testing because of the lower hazard levels. Your organization shall determine the certification and recertification requirements with the concurrence of the Safety and Test Operations Division or the Clinical Services Branch. Category II jobs include, but are not limited to, those listed in this table. Chapter numbers given are for chapters in this Handbook.

## Part 5, Safety and health practices for everyone

<i>For these personnel or operations . . .</i>	<i>Permit req'd . . .</i>	<i>Physio trng req'd?</i>	<i>Med. exam req'd?</i>	<i>Follow requirements in . . .</i>
Operating altitude chambers	HOP	yes	yes	Chapter 6.9
Operating heavy equipment and rigging loads	none	no	yes	Chapter 8.5 and equipment manuals
Operating high-pressure liquid, vapor, or gas systems	none	no	no	n/a
Working with high-voltage electricity	HOP	no	no	Chapters 8.1 and 8.2
Servicing and maintaining equipment with hazardous energy	none	no	no	Chapter 8.2
Operating hyperbaric chamber	HOP	yes	yes	Chapter 6.9
Operating powder-actuated tool	HOP	no	noise only	Chapter 8.6
Using radioactive materials or radiation- producing equipment (ionizing and nonionizing)	HOP	no	no	Chapter 7.3
Operating boiler plants	none	no	noise only	n/a
Operating aerial baskets and truck platforms	HOP	no	no	Chapter 8.7
Working with insulation	none	no	yes	n/a
Operating Class 3B and 4 lasers or solar simulators	HOP	no	yes	Chapter 6.2 (laser only)
Handling cryogenics	HOP	no	no	Chapter 6.5
Pressure suit technicians	none	yes	yes	n/a
Welding (fusion) on flight ground-support equipment	HWP	no	no	Chapter 8.4 and JSC 18323
Hand or automated wire wrapping	none	no	no	MIL-STD-130b
Hand soldering for flight and ground-support equipment	none	no	yes	NASA STD-8739.3
OSHA Class I, II, or III asbestos work	yes	no	yes	Chapter 5.7 and Part 12
<u>Using Self Contained Breathing Apparatus</u>	<u>no</u>	<u>no</u>	<u>yes</u>	<u>n/z</u>

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## 6. Requirements for Category III hazardous operations

Category III jobs involve handling, transporting, and packaging of hazardous materials that do not disturb the integrity of the basic shipping container. Operations that involve the reduction of palletized or otherwise combined items of packaged hazardous materials qualify

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## Chapter 5.8, Hazardous operations: safe practices and certification

as handling. Category III jobs require training, certification, and a hazardous operations permit unless you have a procedure as described in paragraph 13 of this chapter. Your organization will determine the certification period with concurrence from the Safety and Test Operations Division, or the Clinical Services Branch if none is required by state or federal laws. You shall:

- a. Have specific training in federal, NASA, and JSC rules for preparing, packaging, marking, and transporting the material you will handle. Training shall include instruction in how to find both the specific hazards of the material(s) and the standard emergency and first-aid procedures to follow if a spill or exposure to the material occurs. This shall also include a review of the Material Safety Data Sheet(s) before handling or transporting any material.
- b. Pass a written test to show you have the necessary knowledge and skills.
- c. Get a certification card and carry it. The card shall include name, date, materials you may handle, signature of certifying officer, and expiration date.

### 7. Requirements for Category IV hazardous operations

Category IV operations require a hazardous operations permit unless you have a procedure as described in paragraph 13 of this chapter. Medical exams are only required for certain operations. See Chapter 3.6 for more information on medical exams. Category IV jobs include, but are not limited to, those listed in this table. Chapter numbers given are for chapters in this Handbook.

<i>For these personnel or operations . . .</i>	<i>Follow requirements in . . .</i>
Hot work	Chapter 8.4 and paragraph 8 below
Working in acoustic and vibration chambers	Chapter 6.9
Working in acceleration facilities	Chapter 6.9
Working in impact testing facilities	Chapter 6.9
Working in oxygen-enriched or oxygen-deficient atmospheres	n/a
Demolition	29 CFR 1926.850
Using pneumatic and power-actuated devices that incorporate projectiles	Chapter 8.6
Excavation	29 CFR 1926.650 and 1926.651
Proof pressure-testing components or systems	n/a
Transferring, transporting, using, disposing of, or otherwise exposing personnel to cryogenic substances, explosives, radiation, etiological agents, flammable or combustible liquids or solids, propellants, poisons, corrosive or oxidizing materials, or compressed gases	Chapter 5.1 Chapter 8.5 Chapter 9.1

## Part 5, Safety and health practices for everyone

Transporting oversized loads or trailers that would require special permits on public roadways	Chapter 5.3
Working at heights of 20 feet or more	Chapter 8.7
Using "heavy lift" material handling equipment	Chapter 8.5
Doing hazardous waste operations	29 CFR 1910.120 40 CFR Parts 260–279

### 8. Work shift limits for hazardous operations

These limits prevent dangerous situations due to fatigue. They apply to those who are doing hazardous activities as well as to those who are responsible for activities that could result in death, injury, or property damage:

- a. If you do any hazardous operations, you shall:
  1. Never work a shift of more than 12 hours in a 24-hour period.
  2. Be off for at least 10 hours between shifts.
- b. If you do any test support or test facility activities such as facility readiness, repairs, or maintenance, you shall:
  1. Never work a shift of more than 12 hours in a 24-hour period.
  2. Be off for at least 10 hours between shifts.
- c. If you are involved in test team activities that directly support tests, you shall:
  1. Never work a shift of more than 12 hours for continuous testing. Normal and desired shifts are 8 hours.
  2. Have a qualified relief every 4 hours so you can take rest breaks, unless your position allows you to take comfort breaks and have water and food during the test.
  3. Be off for at least 10 hours between shifts.
- d. If you are involved with hypobaric chamber activities, you shall:
  1. Be off for at least 24 hours before the test starts if you work 12-hour shifts during the pretest phase.
  2. Never start a test if the combined pretest hours worked and the test hours scheduled to complete the test will exceed 12 hours. You may use a fresh test team to staff the duty stations of those whose shifts will exceed 12 hours.
  3. Never work more than five 12-hour shifts in a week without a day of rest right after the 60-hour workweek.
  4. Never work more than 8 hours in a 24-hour period at altitude as an inside lock observer. A standard shift at altitude is 4 hours with a maximum of 6 hours. The medical monitor is responsible ~~for not~~ monitoring lock observers for excessive

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## Chapter 5.8, Hazardous operations: safe practices and certification

fatigue ~~in lock observers.~~

5. Never spend more than 6 hours in suit conditions in a hard vacuum. The medical monitor is responsible for ~~monitoring notieing subjects for~~ excessive fatigue ~~in crew members.~~
- e. Have waivers to the requirements in subparagraph a above approved by the Division Chief responsible for the facility.
- f. Have waivers to the requirements in subparagraphs b and c above approved by the director or assistant director responsible for the facility. The request shall include, as needed, the rationale for the waiver, the reason you can't fully comply, alternatives, program impact, hazard assessment, and an assessment by the Space and Life Sciences Directorate. Send a copy of the approved waiver to the Safety and Mission Assurance Directorate.

### *Hot Work Requirements*

#### 9. Requirements for “hot work”

“Hot work” is any work involving burning, welding, or similar operations that is capable of initiating fires or explosions. To do any hot work on cooling towers, anechoic chambers, or mockup areas, first get approval from the Safety and Test Operations Division. Send that office a written statement justifying the need for the work for review and approval. You shall follow these requirements for any hot work:

- a. Never do any hot work outside of a designated hot work area without an approved hot work permit. See subparagraph 12.b of this chapter for more information on permits. See paragraph 11 below for information on designated hot work areas.
- b. To reduce the chance of a fire, notify the facility fire wardens and remove ordinary combustibles.
- c. Post a fire watch to recognize fire hazards, notify appropriate responsible persons in the event of an emergency, start an orderly emergency evacuation when appropriate, and safely use a small portable fire extinguisher. The fire watch shall:
  1. Take appropriate action if potential fire hazards are observed. This includes notifying responsible persons of the observed hazards.
  2. Prevent fires from occurring. For example, be aware of where falling sparks may land and prevent them from falling into any sewer system or onto combustible materials. Maintain adequate clearance between ignition sources and combustible materials.
  3. Maintain a close watch on any locations where hot work has been done to make sure there are no imbedded hot spots or flare-ups.
  4. Notify the Emergency Operations Center (x33333 at JSC and Sonny Carter Training Facility or x44444 at Ellington Field) and building occupants of a fire and start an

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evacuation.

5. Extinguish small fires if it can be done safely.

### 10. Permit-required hot work areas

A permit-required area is an area that is made fire-safe by removing or protecting combustibles from ignition sources. A hot work permit is required for any hot work. See subparagraph 12.b of this chapter for more information. The Safety and Test Operations Division and the Clinical Services Branch shall review permit-required hot work areas during each annual safety, health, and fire protection inspection.

### 11. Designated hot work areas

A designated hot work area is a permanent location that is approved for hot work operations that will be done regularly. To set up a designated hot work area, you shall:

- a. Form a team to review the area. The review includes an on-site survey of the area and a meeting to discuss any discrepancies or concerns. The team shall consist of the following individuals as a minimum:
  1. Safety and Test Operations Division representative.
  2. Clinical Services Branch representative.
  3. Fire Protection engineer.
  4. Facility Manager.
  5. Contractor Safety Representative for contractor operations.
  6. Line manager(s) over the proposed area.
- b. Meet the following requirements:
  1. The area shall be a specific area designed or approved for hot work, such as a maintenance shop or a detached outside location.
  2. The structure shall be made of noncombustible or fire-resistive materials, essentially free of combustible and flammable contents, and suitably segregated from adjacent areas.
  3. Chapters 5.1, "Fire safety," and 8.4, "Welding, cutting, and brazing safely," of this Handbook.
  4. NASA-STD-8719.11, "Safety Standard for Fire Protection."
  5. National Fire Protection Association Standard 1, "National Fire Prevention Code."
  6. National Fire Protection Association Standard 51B, "Standard for Fire Prevention During Welding, Cutting and Other Hot Work."
- c. Submit a plan to the team in subparagraph a above. The plan shall include, as a

## Chapter 5.8, Hazardous operations: safe practices and certification

minimum:

1. A description of the process and related activities planned.
  2. Location and floor plan, indicating the location of extinguishers, pull stations, phones, emergency egress routes, nearest flammable and combustible materials, etc.
  3. The type of fire alarm and suppression systems in the area.
  4. A list of any associated hazards and controls.
  5. A hazard analysis for the planned activities.
  6. A Job Safety Analysis for the planned activities.
  7. An Emergency Evacuation Plan.
  8. An air quality survey.
  9. A list of responsible individuals and contacts.
- d. Attach a signature page to the plan that shall include concurrence signatures of the review team members (subparagraph a above) once their concerns have been identified and addressed.
- e. Present the plan, with concurrences noted on signature page, to the JSC Authority Having Jurisdiction or the Chief, Safety and Test Operations Division, or both for final approval.
- f. Keep one copy conspicuously posted in the designated hot work area and provide another to the JSC Fire Specialists.
- g. Reevaluate the area yearly.

### *Permits and procedures*

#### 12. Permits for hazardous operations

You need to have a permit for certain hazardous operations before you may begin work. Fill out the permit form and post the completed permit at the job site until the job is over. Some operations, such as welding in a confined space, require two or more permits. Permits are only good for a limited time, such as one shift, and expire on the date and time shown on the permit. You shall have one of the following permits as required and post it at the job site along with any procedures you will use:

- a. A **confined space entry permit** any time you enter a confined space. See Chapter 6.10, "Entering confined spaces," for more details.
- b. A **hot work permit** any time you do any work involving burning, welding, or similar operations that is capable of initiating fires or explosions outside a designated hot work area. Use JSC Form 1475, "Hot Work-Welding-Cutting Permit," Appendix 5A. Electric soldering irons, hot plates, coffee pots, and similar appliances don't require a permit. Hot work permits are valid for no longer than 1 week. The flowchart in figure 5.8-1 describes

## Part 5, Safety and health practices for everyone

the steps to complete a hot work permit.

NOTE: As a fire warden, contractor safety representative, safety point of contact, or facility manager, you shall contact the Clinical Services Branch if you suspect any exposure or health issue with the hot work.

- c. A ***hazardous operations permit*** for other operations as required by paragraphs 4 and 5 of this chapter. Use JSC Form 8, “Hazardous Operation Permit,” Appendix 5A. The flowchart in figure 5.8-2 describes the steps necessary to complete and approve a hazardous operations permit.

## Chapter 5.8, Hazardous operations: safe practices and certification

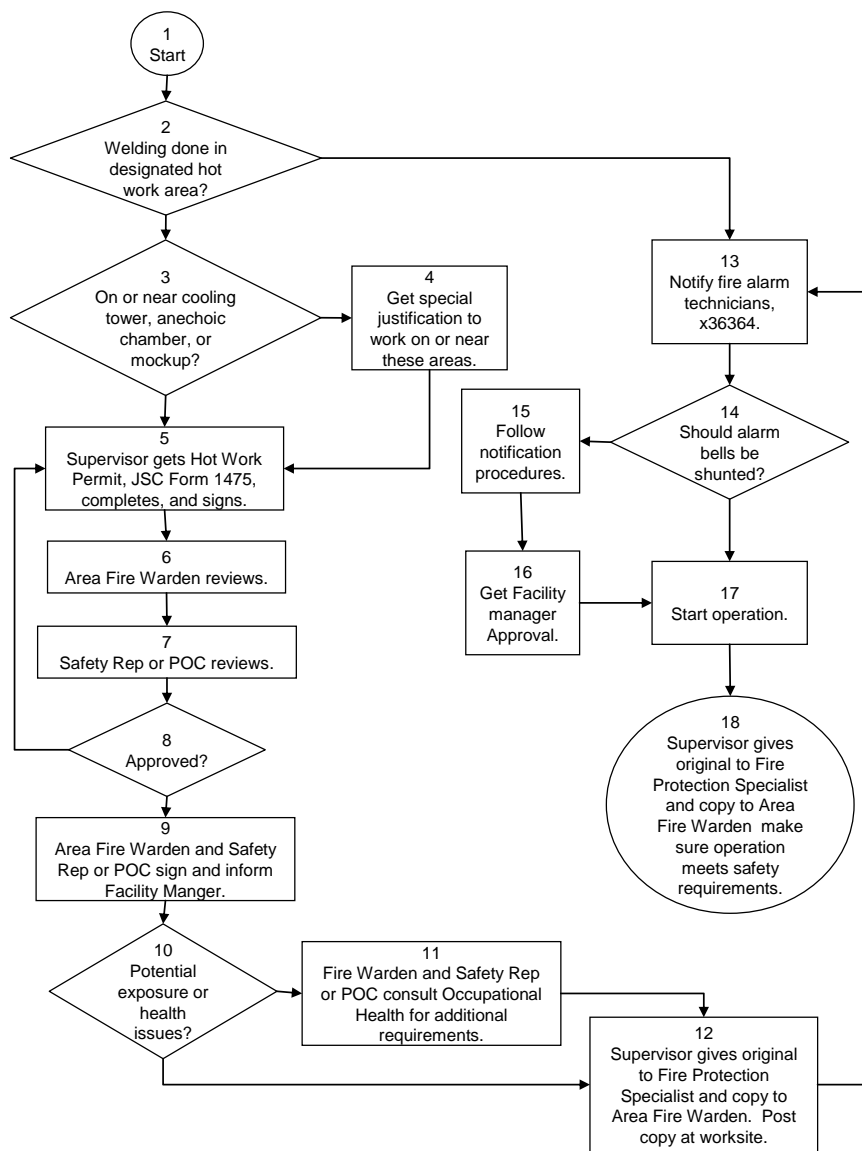


Figure 5.8-1, Hot work permit flow chart

**Part 5, Safety and health practices for everyone**

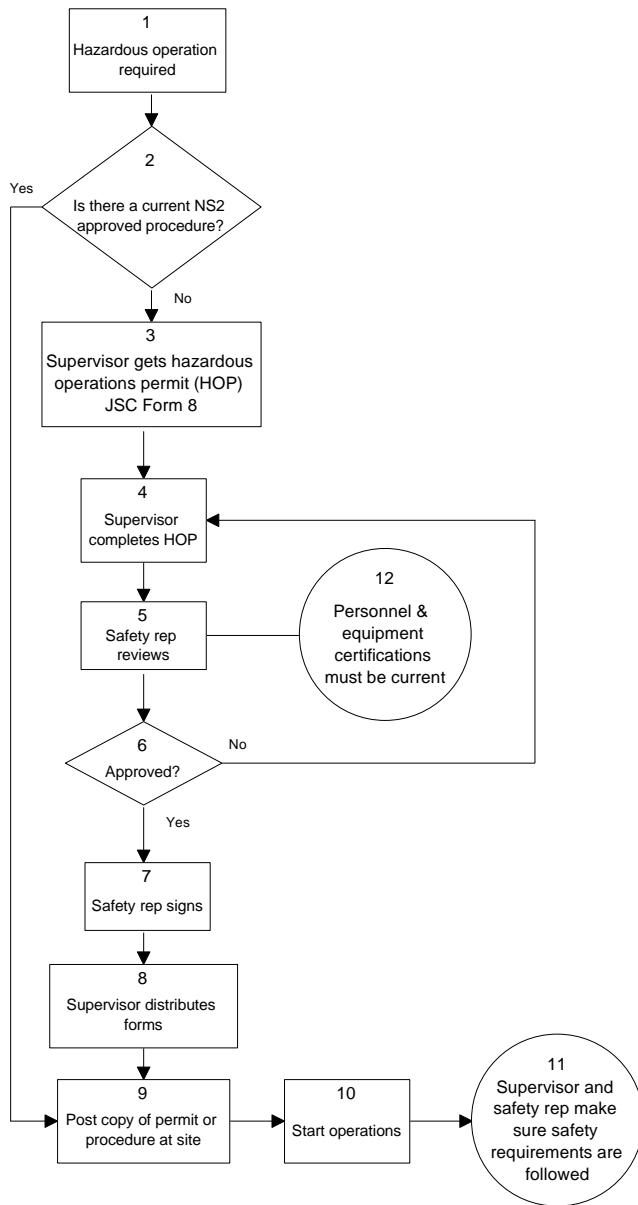


Figure 5.8-2. Hazardous operations permit flowchart.

## Chapter 5.8, Hazardous operations: safe practices and certification

### 13. Exceptions to permit requirements

You don't need a hazardous operations permit if you write a detailed procedure and have it approved by the Safety and Test Operations Division. The procedure ~~needs to~~shall include a statement that says, "This document contains hazardous operations." Confined space entry and hot work permits are always required. To use a procedure, you shall:

- a. Include the title and telephone extension of each person who would normally receive a copy of the permit with the procedure.
- b. Include enough detail to identify residual hazards and cautions to personnel.
- c. Conspicuously mark the title page with a statement that the document contains hazardous procedures and strict adherence is necessary for safety and health.
- d. Contact those you listed under subparagraph a above to let them know about your work before you start.
- e. Post a copy of the procedure at the job site as you would post a permit.
- f. Send any revisions to the procedure to the Safety and Test Operations Division for review and approval.
- g. Review and update the procedures at least yearly.

### *Certification for hazardous operations*

### 14. Certification process

To be certified, you need to show that you have the necessary knowledge, skills, judgment, and physical ability to do the job safely. JSC will provide and document your training and certification. Certification shall follow these requirements:

- a. You shall be certified by your management after you:
  1. Complete the necessary formal or on-the-job training. Your management shall at least outline the on-the-job training you need to have and state the minimum number of hours required. Training shall include applicable requirements from 29 CFR 1910, "Occupational Safety and Health Standards," 29 CFR 1926, "Safety and Health Regulations for Construction," and applicable NASA and JSC requirements.
  2. Pass an ~~oral test~~, written test, ~~or experience review~~.
  3. Get a certification card when the certification examiner determines that you have the required safety knowledge and skills. The certification examiner and certifying officer shall both sign the card. You may use JSC Form 353, Appendix 5A. See NPR 8715.3, "NASA General Safety Program Requirements," Chapter 7, "Safety Training and Personnel Certification," for more information.
- b. Your organization shall keep a record of your certification on JSC Form 209, "Application and Record of Qualification for Personnel Certification," Appendix 5A, or a

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## **Part 5, Safety and health practices for everyone**

similar form.

- c. Certification examiners shall:
  - 1. Know the requirements of the operation that they will certify.
  - 2. Be at least one organizational level higher than the employee to be certified.
  - 3. Be appointed by the Center Director or his or her designated representative to certify Category I operations.
  - 4. Be appointed by a directorate-level official or representative from the organization responsible for the operations to certify Category II or III operations.
- d. Certification is good for 3 years or less if necessary. The certifying officer and your management may request that you be recertified or retested:
  - 1. Any time they question your knowledge or skills.
  - 2. When you have to do any new hazardous operation.
- e. You shall have a physical examination when required by paragraphs 4 or 5 of this chapter or by the Clinical Services Branch to be certified or recertified.

### **15. Exceptions to the requirements in paragraph 14 above**

Certifications for operations other than the categories of hazardous operations mentioned in this chapter are exempt from the requirements of this chapter.

### **16. How you could lose your certification**

You will lose your certification if you:

- a. Leave JSC or your company.
- b. Fail the recertification exam or fail to retain the required knowledge and skills.
- c. Are transferred or reassigned and no longer do the operations you are certified for.
- d. Fail to pass a required medical examination.
- e. Are past your recertification date.

### *Other requirements and responsibilities*

### **17. Hazardous duty pay**

Never use anything in this chapter to justify hazardous duty payments, environmental differential pay, or premium pay. Jobs that qualify for hazardous duty pay aren't necessarily covered by this chapter. See part 5, subpart 6 of the JSC Personnel Manual for information on hazardous duty pay.



## Chapter 5.8, Hazardous operations: safe practices and certification

### 18. For more information on hazardous operations

You can find more information on hazardous operations in these documents:

- a. 29 CFR 1910.38, “Employee Emergency Plans and Fire Protection Plans”
- b. NPR 8715.3, Chapter 3.

### 19. Responsibilities for hazardous operations

- a. As a *supervisor*, you are responsible for:
  1. Getting, completing, and distributing required permits.
  2. Monitoring hazardous operations to make sure that the requirements on the permit and in this chapter are followed for any hazardous operation.
  3. Providing detailed safety instructions for safe operations to employees who are authorized access to hazardous areas or who do hazardous operations.
  4. Identifying operations that could be hazardous. Analyze these operations to determine the risk to personnel, equipment, and facilities.
- b. As a *line manager*, you are responsible for:
  1. Making sure that hazardous operations that require certification are done only by employees with a valid certification.
  2. Managing a training and certification program for your organization. This includes providing all training and testing necessary to qualify your employees and certifying them after they show that they have the necessary knowledge and skills.
  3. Keeping a master list of: all operations that require certified personnel, employees that are certified for those operations, certification examiners, and certification officers in your organization.
  4. Keeping completed certificates and supporting records current. Protect employee training records under NPD 1382.17 (current version), “Privacy Act – Internal NASA Direction in Furtherance of NASA Regulation.”
  5. Recommending candidates for certification examiners.
- c. As a *safety representative, competent person, or certified confined space supervisor*, you are responsible for reviewing each permit to make sure that the requirements are followed and that personnel listed on permits have valid and current certifications if required.
- d. As a *contracting officer*, you are responsible for making sure contracts contain hazardous operations requirement as necessary.

## Part 5, Safety and health practices for everyone

- e. The ***Safety and Test Operations Division*** is responsible for:
  - 1. Reviewing all operations being done at JSC or JSC field sites yearly to identify those that could be hazardous. Employee safety and health committees and employee representatives will help identify hazardous operations as requested.
  - 2. Monitoring JSC operations to make sure that only certified personnel are assigned to the tasks described in this chapter.
  - 3. Surveying selected areas to determine the effectiveness of the certification program.
  - 4. Keeping metrics on the waivers and mishaps related to the waivers.
- f. The ***Clinical Services Branch*** is responsible for setting requirements for hazardous operations involving potential health hazards, sampling and monitoring environmental conditions, and providing professional medical support and surveillance as needed.
- g. The ***Employee Development Branch*** is responsible for providing training courses for hazardous operations as requested by line management and the Safety and Test Operations Division. These courses shall qualify personnel for certification.

# **Chapter 5.10**

## **Cardiopulmonary Resuscitation (CPR) and Automated External Defibrillator (AED) Program**

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### ***This could be you . . .***

*An employee began having chest pain shortly after coming to work. Minutes later, he collapsed on the floor. A fast acting employee called 33333 and shouted for help. After evaluating the patient and starting CPR another employee responded with an AED unit and was able to shock the heart into a normal rhythm.*

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### **1. Who must follow this chapter**

You shall follow this chapter if you work at JSC or a JSC field site.

### **2. What this chapter covers**

This chapter defines JSC's Cardiopulmonary Resuscitation (CPR) and Automated External Defibrillator (AED) program including training, maintenance, certification, auditing and placement. JSC is committed to improving the chances of survival for any employee or visitor that may suffer from sudden cardiac arrest.

### **3. Why CPR and AED's are important**

JSC shall follow the guidelines of the American Heart Association (AHA) for Public Access to Defibrillation and JSC is committed to providing AED capability within 5 minutes to all locations at JSC. This is accomplished by a combination of Ambulance and Fire Protection Specialists emergency responders and placement of AEDs in facilities across JSC.

Note: Each year, at least 250,000 Americans die of sudden cardiac arrest before they reach the hospital. Sudden cardiac arrest strikes people of all ages and all degrees of fitness usually without warning. Many of these lives can be saved if bystanders quickly phone the JSC emergency numbers (33333/44444/911), begin CPR and use an AED. Figure 5.10-1 illustrates the coordinated set of actions to improve survival.

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Figure 5.10-1: American Heart Association Chain of Survival

### 4. Elements of a complete AED/CPR program

JSC's AED/CPR program shall include these five program elements:

- a. **Management Support:** Agreement about the goals, responsibility, implementation requirements and costs of the program.
- b. **Employee Participation:** Demonstrated by recognizing the signs and symptoms of a heart attack, knowing the chain of survival and volunteering to be a CPR/AED lay responder.
- c. **Emergency Responders:** Designated fire protection specialists, health care professionals and others whose primary duty is emergency response.
- d. **Training:** Managers, supervisors, and employees in the CPR/AED program knowledgeable in their role.
- e. **AED Placement:** Assessing the proper number and placement of AED's and supplies.

### 5. Involvement in JSC's CPR and AED program

The following individuals shall be involved in JSC's CPR and AED program:

- a. If you are a **manager**, you must be committed to maintaining the AED equipment provided as part of your commitment to maintaining a safe and healthful workplace. You shall:
  1. Assign a person to maintain the AED and associated equipment located in your facility. Nominally this person should be the primary or alternate facility manager.
  2. Ensure that your facility Emergency Action Plan includes the cardiac chain of survival and the location of any AED's in the building.
- b. If your job **requires** you to be certified in CPR or AED operation (e.g., Physician, Nurse, Paramedic, Fire Protection Specialist, Childcare Worker, Electricians) you shall maintain training and certification through the AHA, American Red Cross (ARC), or National Safety Council (NSC).
- c. If you are an **employee** at JSC, your participation is needed to make the CPR/AED program a success. You may participate by:

## Chapter 5.10, CPR and AED's

1. Learning the risk factors and take steps to prevent cardiovascular disease.
2. Learning the signs and symptoms of heart attacks and immediately call the emergency numbers if you or a co-worker experience chest pain.
3. Volunteering to be a lay rescuer by learning CPR and how to use an AED.

### 6. Who may perform CPR and use an AED

To perform CPR or use an AED, you shall have a current certification by the AHA, ARC or NSC.

### 7. Placement of AED's

JSC has an established AED program. You can find details about the AED program including locations at: <http://sd.jsc.nasa.gov/omoh/scripts/HumanTestSupport.aspx>. The JSC Crash Cart and AED working group will decide future placement of AED's and placement shall meet the following criteria:

- a. Are more than 200 employees assigned to the building during normal working hours?
- b. Do workers engage in activities that increase risk (on second or third shift when the JSC Clinic is closed, e.g. exercise facilities, electrical, machine shops, printing, etc.?)
- c. Is the facility remote from the JSC Clinic or JSC Emergency Responders such as Ellington Field or the Sonny Carter Training Facility?
- d. Is this a multi-story building or a building with a configuration that may slow the Fire Protection Specialist or Emergency Medical Technician response?

### 8. CPR and AED Training Program

JSC offers free CPR and AED training with sign-up through SATERN. In the course catalog, search for "JSC-OHS-CPR" This training consists of two classes: Adult CPR/AED and an optional Child/Infant CPR. These courses provide JSC workers with AHA certification in Adult CPR/AED and Child/Infant CPR. The training combines lecture, video demonstrations, take-home manuals, and hands-on manikin training and also includes a description of AED's located throughout JSC. Classes are small in size and fill quickly so it is important you attend on the scheduled day.

The AHA and NSC require that you recertify every two years, the American Red Cross requires retraining annually.

Facility managers or their designees shall be trained to perform the maintenance check by the Clinical Services Branch.

### 10. Responsibilities for the JSC CPR and AED program

The following have responsibilities in the JSC CPR and AED program:

## **Part 5, Safety and Health Practices for Everyone**

- a. The Clinical Services Branch has overall responsibility for the formal CPR/AED program. Clinical Services shall:
  1. Assign the AED Program Coordinator
  2. Develop operational protocols and procedures to be included in the JSC Emergency Preparedness Plan.
  3. Assist other organizations in developing specific programs
  4. Train employees.
  5. Review and approve/reject requests for AED's
  6. Audit AED maintenance, record discrepancies in HATS.
- b. Facility Manager's or their designees are responsible for maintaining the AED's in cooperation with the Clinical Services Branch and shall:
  1. Inspect the AED and accessory bag weekly. Record the results of the inspection on the sheet provided.
  2. Report discrepancies to the JSC AED coordinator at the number listed on the AED. The number is x25724 or x25728.
  3. Detailed instructions on AED maintenance, inventory and blank inspection sheets are found in the JWI 1040.12, JSC Emergency Preparedness Plan, Annex H.

## **11. Legal concerns**

Most states including Texas have passed " Good Samaritan Laws" to protect those who, in good faith, administer emergency care including using an AED at the scene of an emergency from liability in civil damages unless you are willfully or wantonly negligent. This is covered in greater detail in the CPR and AED class.

## **13. What if happens if you actually perform CPR or use an AED**

Following the administration of CPR and/or the use of an AED, the AED physician director shall review the incident with you. This review is intended to provide feedback to improve our program if necessary. Additionally, you will be offered an opportunity to schedule a stress debriefing with the Employee Assistance Office to discuss the event, patient outcome and receive information on post-incident reaction management.

## **15. For more information on CPR and AED's**

You can find more information about CPR and AED's at:

- a. Human Test Support Group: <http://sd.jsc.nasa.gov/omoh/scripts/HumanTestSupport.aspx>

## Chapter 5.10, CPR and AED's

- b. American Heart Association: [www.americanheart.org](http://www.americanheart.org)
- c. American Red Cross: <http://www.redcross.org/services/hss/courses/>





# Chapter 6.5

## Working safely with cryogenic fluids

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### ***This could be you . . .***

*Two technicians passed out while transferring liquid nitrogen from a truck because nitrogen spilled into the loading dock and displaced oxygen in the area. They were rescued and are okay.*

*A liquid helium dewar ruptured. Fortunately, no one was in the room at the time.*

*A liquid nitrogen dewar exploded and sent glass fragments flying. Fortunately, the technicians working with the dewar were not in the path of the flying glass.*

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### **1. Applicability of this chapter**

You are required to follow this chapter if you:

- a. Use, handle, store, or transfer cryogenic fluids as a part of your job.
- b. Supervise anyone who does the above tasks.

### **2. What this chapter covers**

This chapter covers the minimum requirements to handle and use common cryogenic fluids safely.

### **3. Definition of a cryogenic fluid**

A cryogenic fluid is a liquid with a normal boiling point below  $-238^{\circ}\text{F}$  ( $221^{\circ}\text{R}$ ,  $-150^{\circ}\text{C}$ ,  $123\text{ K}$ ). Commonly used cryogenic fluids include the following:

- a. Liquid helium (LHe) – normal boiling point  $-452^{\circ}\text{F}$
- b. Liquid hydrogen (LH<sub>2</sub>) – normal boiling point  $-423^{\circ}\text{F}$
- c. Liquid nitrogen (LN<sub>2</sub>) – normal boiling point  $-320^{\circ}\text{F}$
- d. Liquid oxygen (LO<sub>2</sub>) – normal boiling point  $-297^{\circ}\text{F}$
- e. Liquid air (Lair) – normal boiling point  $-318^{\circ}\text{F}$
- f. Liquid argon (LAr) – normal boiling point  $-303^{\circ}\text{F}$

Fluorine, neon, carbon monoxide, methane, nitric oxide, and krypton can be liquefied and are cryogenic fluids, but are rarely used at JSC in the liquid state.

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### 4. Hazards of cryogenic fluids

Cryogenic fluids could cause any of the following safety problems:

- a. Cryogenic burns from the extreme cold, eye damage from cold vapors.
- b. Skin stuck to cold surfaces.
- c. Over-pressurization and rupture of a pressure system or vessel—when cryogenic fluids try to vaporize due to heating from the surroundings, they can increase the pressure 700 to 1000 times.
- d. Asphyxiation.
- e. Upper respiratory irritation from breathing cold vapors.
- f. Fire and explosion.
- g. Leaks, sprays, or spills contacting nearby equipment and causing structural failures due to excessive thermal stresses within the materials.

### *Requirements for all cryogenic fluids*

### 5. Precautions to observe when working with any cryogenic fluids

If you handle any cryogenic fluids, you shall observe these precautions:

- a. Do tasks involving cryogenic fluids with two or more people, except for laboratory use from a small close container.
- b. Deactivate systems with proper energy controls found in Chapter 8.2, “Lockout/tagout practices,” of this handbook before you start any maintenance or repair work.
- c. Vent cryogenic systems through appropriate valves. Release gases so that the wind or room ventilation will direct them away from people.
- d. If you need to put warm objects in cryogenic fluids, do it slowly and use tongs to insert or remove the objects.
- e. If you need to put a cryogenic fluid into a warm container, do it slowly to minimize boiling, splashing, and thermal stresses.
- f. Keep unprotected body parts away from the cold surfaces of pipes or vessels that contain cryogenic fluids.
- g. Leave frost that forms on un-insulated surfaces undisturbed to help prevent Lair (LN<sub>2</sub> plus LO<sub>2</sub>) from accumulating.
- h. Do a written hazard analysis for any area where cryogenic fluids are used or stored.
- i. Make sure you have a procedure or hazardous operations permit as described in Chapter 5.8, “Hazardous operations: safe practices and certification,” of this Handbook.
- j. Ensure that all personnel involved are trained in the safe handling of cryogenic fluids.

## Chapter 6.5, Working safely with cryogenic fluids

### 6. Locations for working with cryogenic fluids

Any work that you do with cryogenic fluids shall be:

- a. Near safety and firefighting equipment that you properly maintain.
- b. Away from combustibles.
- c. Away from unprotected or unauthorized personnel.
- d. In well-ventilated areas. Use oxygen analyzers and alarms to monitor for low oxygen concentrations, as required by the hazard analysis, if you are working with LHe, LH<sub>2</sub>, LN<sub>2</sub>, or LAr. Use oxygen analyzers and alarms to monitor for high oxygen concentrations if you are working with LO<sub>2</sub>.

### 7. Storing cryogenic fluids

Locations where cryogenic fluids are stored shall follow these requirements:

- a. Store cryogenic fluids outside or in large, open, and well-ventilated rooms that are vented to the outside. Use oxygen analyzers and alarms as described in subparagraph 6.e above.
- b. Continuously ventilate any area where inert cryogenic fluids are used, even at night and on weekends, unless you remove them from the area. Leave air handlers or exhaust ventilation on at all times.
- c. Label the entrance to any area with inert cryogenic fluids to alert personnel that asphyxiation is possible in that area due to oxygen-displacing cryogenics.
- d. If you store LH<sub>2</sub> inside, make sure to vent any gas that escapes either to the outside or to a safe location. If you vent the gas through ductwork, the ductwork shall be independent of other systems and contain no ignition sources.
- e. You shall use hydrogen detectors (either permanently installed or portable) wherever you use hydrogen.
- f. Within 3 feet of hydrogen sources (such as where connections are regularly made and disconnected), you shall use Class I, Division 1, Group B electrical equipment as described in National Fire Protection Association Standard 70, "National Electric Code."
- g. Between 3 and 25 feet of hydrogen sources, you shall use Class I, Division 2, Group B electrical equipment.

### 8. Action to take in case of a skin burn from a cryogenic fluid

If you spill any cryogenic fluid on you, seek immediate medical attention or call x33333 (at JSC and Sonny Carter Training Facility) or x44444 (at Ellington Field).

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### 9. Precautions for storing, using, or transferring cryogenic fluids

If you transfer, use, or store any cryogenic fluids, you shall observe these precautions:

- a. Transfer liquid slowly to reduce thermal shock to containers.
- b. Don't breathe cryogenic vapors.
- c. Don't allow ice to accumulate on a neck of or near the vent of a cryogenic vessel. Ice could plug the vent and cause the vessel to rupture.
- d. Empty and purge any cryogenic vessel with ice accumulating on the outer surface and either dispose of it or take it out of service for repair. The ice indicates a poor vacuum in the annular space resulting in poor insulation.
- e. Tape or cage exposed portions of glass containers to minimize flying glass if the glass breaks.
- f. Follow these requirements to prevent sparks or arcs:
  1. Ground all stationary hydrogen and oxygen equipment.
  2. Bond mobile and stationary equipment used to transfer and receive LAr, LO<sub>2</sub>, and LH<sub>2</sub> and make sure that all equipment involved in the transfer shares a common ground.
  3. Purge all condensable gases from LH<sub>2</sub> transfer hoses in service with helium gas. Transfer LH<sub>2</sub> only with specially designed equipment.

### *Requirements for certain cryogenic fluids*

### 10. Precautions for handling LN<sub>2</sub>

As a gas, nitrogen is colorless, odorless, tasteless, nontoxic, and almost totally inert as described in Attachment 6.5D, Appendix 6B. The main health hazard of nitrogen is asphyxiation. Nitrogen can displace oxygen in the air in enclosed or semi-enclosed areas. If you use or handle LN<sub>2</sub>, you shall observe these precautions:

- a. Don't enter a tank, sump, or closed space that has contained LN<sub>2</sub> until you have purged the space and stabilized the oxygen concentration at normal levels. Air testing is required to document that oxygen concentration is at a safe level. To enter an oxygen-deficient space:
  1. You shall wear an air-supplying breathing apparatus.
  2. The Safety and Test Operations Division and the Clinical Services Branch shall approve the entry. An approved confined space entry procedure and permit may also be required (see Chapter 6.10).
  3. ~~Entry into a contaminated space to do routine work is prohibited.~~ If it is necessary to enter, specially trained rescue personnel shall stand by to rescue entry personnel immediately during an emergency.

## Chapter 6.5, Working safely with cryogenic fluids

- b. Isolate the LN<sub>2</sub> source using a minimum of two positive blocks, such as valves, between the source and the system or equipment. The Safety and Test Operations Division shall approve any other arrangement.
- c. If you use valves to block a system, chain or lock them to prevent accidental opening and tag them with DO NOT OPERATE tags. See Chapter 8.2 of this handbook for detailed requirements on lockout/tagout.
- d. If you use an open bleed valve to prevent nitrogen pressurization, chain or lock it open to prevent pressure buildup between blocks or flanges and vent it to outside the work area.
- e. Use blank or blind flanges as necessary. If the system contains no bleed valves, install a bleed valve on each flange.

### 11. Precautions for handling LO<sub>2</sub>

Oxygen is nonflammable but vigorously supports and accelerates combustion as described in Attachment 6.5B, Appendix 6B. Many substances will burn or explode more easily in an oxygen-enriched atmosphere. If you handle LO<sub>2</sub>, you shall follow these precautions to avoid fires or explosions:

- a. Don't allow any organic materials or flammable substances to come in contact with LO<sub>2</sub> or oxygen-enriched atmospheres. Some of the organic materials that can react violently with oxygen are oil, grease, asphalt, kerosene, cloth, tar, and dirt that contain oil or grease.
- b. Open and close valves in LO<sub>2</sub> systems slowly.
- c. Remove clothing soaked or splashed with LO<sub>2</sub> or oxygen vapors and place it in a well-ventilated area away from flammable and combustible materials for at least 30 minutes. See paragraph 8 of this chapter for cautions on removing clothing from a person with a cryogenic burn.
- d. Avoid or leave any area exposed to an oxygen-enriched atmosphere. Avoid all sources of ignition.
- e. Don't do welding, cutting, or spark-producing operations within 100 feet of LO<sub>2</sub> storage units or pipes without monitoring the oxygen levels with an oxygen analyzer. Don't do these operations if the work area atmosphere is oxygen-enriched. You may monitor oxygen levels intermittently or continuously at the discretion of the Safety and Test Operations Division or the supervisor.
- f. Don't smoke around oxygen systems. Post NO SMOKING signs around oxygen systems. Don't smoke for at least 30 minutes after exposure to LO<sub>2</sub>; oxygen tends to cling to your clothing.
- g. Keep a fire extinguisher available wherever an exposure to LO<sub>2</sub> can occur.
  - 1. If most of the material that could be exposed to the LO<sub>2</sub> is paper or wood (Class A fuel), keep a 2½-gallon water-filled fire extinguisher within 75 feet. Dry chemical

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extinguishers are ineffective against this type of fire.

2. If most of the material that could be exposed to the LO<sub>2</sub> is oil or grease (Class B fuel), keep a 10-pound dry chemical (60-B:C) or multipurpose (4-A:60-B:C) extinguisher within 50 feet.
- h. Don't enter a tank, sump, or closed space that has contained LO<sub>2</sub> until you have purged the space and stabilized the oxygen concentration levels. Air testing is required to confirm that the atmosphere is neither oxygen deficient nor oxygen enriched. The Safety and Test Operations Division shall approve any space with an oxygen-enriched atmosphere. An approved confined space entry procedure and permit may be required.
- i. Isolate the LO<sub>2</sub> source by using a minimum of two positive blocks, such as valves, between the source and the system or equipment. The Safety and Test Operations Division and Clinical Services Branch shall approve any other arrangement.
- j. If you use valves to block a system, chain or lock them to prevent accidental opening and tag them with DO NOT OPERATE tags. See Chapter 8.2 of this handbook for detailed requirements on lockout/tagout.
- k. If you use an open bleed valve to prevent oxygen pressurization, chain or lock it open to prevent pressure buildup between blocks or flanges and vent it to outside the work area.
- l. Use blank or blind flanges as necessary. If the system contains no bleed valves, install a bleed valve on each flange.

## 12. Precautions for handling LH<sub>2</sub>

LH<sub>2</sub> vaporizes rapidly, is very flammable, and burns with an invisible flame as described in Attachment 6.5C, Appendix 6B. Gaseous hydrogen can be "self-igniting" when released under high pressure. At ordinary temperatures, hydrogen is very light. However, LH<sub>2</sub> vapors are slightly heavier than 70°F air and can spread along the ground for considerable distances. If you handle LH<sub>2</sub>, you shall observe these precautions to avoid a fire or explosion:

- a. Keep combustible materials away from hydrogen.
- b. Don't do welding, cutting, or spark-producing operations within 100 feet of hydrogen storage units, flare stacks, vent lines, or pipes. Use a hydrogen detector to make sure there is no hydrogen in the area.
- c. Don't do any welding, cutting, or spark producing operations on components of a LH<sub>2</sub> system until you drain them and purge them with an inert gas.
- d. Don't enter a tank, sump, or closed space that has contained LH<sub>2</sub> until you have purged the space and stabilized the oxygen concentration at normal levels. Air testing is required to determine that the oxygen atmosphere is within safe levels. The Safety and Test Operations Division and Clinical Services Branch shall approve any entry into a space with a flammable or oxygen-deficient atmosphere. See paragraph 10. a. for restrictions on entry into a contaminated space. An approved confined space entry procedure and permit may be required (see Chapter 6.10).

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- e. Isolate the LH<sub>2</sub> source by using a minimum of two positive blocks, such as valves, between the source and the system or equipment. Make sure the line section between the valves has a safety relief device or bleed valve. The Safety and Test Operations Division shall approve any other arrangement.
- f. If you use valves to block a system, chain or lock them to prevent accidental opening and tag them with DO NOT OPERATE tags. See Chapter 8.2 of this handbook for detailed requirements on lockout/tagout.
- g. If you use an open bleed valve to prevent hydrogen pressurization, chain or lock it open to prevent pressure buildup between blocks or flanges and vent it to outside the work area.
- h. Use blank or blind flanges as necessary. If the system contains no bleed valves, install a bleed valve on each flange.
- i. Keep a 10-pound multipurpose (4-A:60-B:C) or a 10-pound CO<sub>2</sub> (10-B:C) fire extinguisher within 50 feet of potential fuel sources.

### 13. Actions to take for an LO<sub>2</sub> spill or fire

Take the following actions in case of an oxygen spill or fire:

- a. Keep all ignition sources, equipment, and people away from LO<sub>2</sub> spills for at least 30 minutes after all frost or fog has disappeared. The spill area surfaces, especially asphalt, could ignite from friction or shock.
- b. Attempt to extinguish an LO<sub>2</sub> fire with hand fire extinguishers immediately because many materials burn rapidly in LO<sub>2</sub>. Then quickly evacuate the area in an orderly manner.

### 14. Actions to take for an LH<sub>2</sub> spill or fire

Take the following actions in case of a hydrogen spill or fire:

- a. Shut off the hydrogen flow as soon as possible, and especially before attempting to extinguish a hydrogen fire.
- b. Remember, hydrogen burns with an invisible flame.
- c. If no hydrogen flame detector is available, use a long piece of wood or other combustible material to probe for flames before approaching the area of the spill.
- d. Spray water on the spill to prevent a fire.
- e. Spray large quantities of water on adjacent equipment to cool the equipment.
- f. Attempt to extinguish only small fires.

### 15. Special precautions for handling other cryogenic fluids

If you use any cryogenic fluids not mentioned above, contact the Safety and Test Operations Division for additional safety requirements. Other cryogenic fluids may include LAr or LHe.

### *Other requirements for cryogenic fluids*

#### **16. Protective clothing and equipment to use when handling cryogenic fluids**

When you work with cryogenic fluids, you shall wear the protective equipment that is appropriate for the hazards of the task you are doing. The following list includes common protective equipment for working with cryogenic fluids:

- a. Eye protection
- b. Face shields
- c. Insulated gloves with gauntlets—the gloves should be loose fitting
- d. Cuff-less trousers outside of boots or work shoes; don't wear tennis shoes or open-toed shoes
- e. Coveralls or smocks, with long sleeves, approved for use with the cryogen you are using

See Chapter 5.6, "Personal protective equipment," of this handbook for more requirements on protective equipment.

#### **17. Training to work with cryogenic fluids**

You need to be certified to handle cryogenic fluids as described in Chapter 5.8 of this handbook. Your training shall cover the following subjects for each cryogenic material you work with:

- a. Nature and properties of the cryogenic fluid in both liquid and gaseous states.
- b. Correct personal protective equipment to use in specific environments and where you can find it.
- c. Approved materials that are compatible with the cryogenic fluid.
- d. Proper use and care of protective clothing and equipment.
- e. First-aid procedures.
- f. Emergency procedures for handling situations such as leaks, spills, and fires.
- g. Good housekeeping practices.

#### **18. Design requirements for cryogenic areas and systems**

In addition to the standards listed in paragraph 19 below, systems handling cryogenic fluids shall meet these requirements:

- a. Insulate cryogenic vessels and lines or provide drip pans under exposed pipes.
- b. Insulate cryogenic containers.



## Chapter 6.5, Working safely with cryogenic fluids

- c. Provide frangible (burst) discs or other pressure-relief devices between the inner vessels and outer tank shell so that pressure rupture cannot occur.
- d. Provide frangible (burst) discs or other pressure-relief devices between sections of a cryogenic fluid system that may trap LO<sub>2</sub>, such as between two valves.
- ~~e. Provide emergency showers and eyewashes for quick drenching or flushing in accessible locations that require no more than 10 seconds to reach.~~
- ~~f.e.~~ Provide enough continuous ventilation and hazardous gas monitors where accidental releases or spills could occur, as indicated by the hazard analysis.

### 19. Other requirements to follow while handling cryogenic fluids

In addition to the requirements in this chapter, you shall follow these standards as they apply to the work you do. Chapter numbers are for chapters in this handbook.

<i><b>For . . .</b></i>	<i><b>Follow this standard . . .</b></i>
Working with cryogenic fluids	29 CFR 1910.103 and 29 CFR 1910.104
Certifying employees to work with cryogenic liquids	Chapter 5.8 of this handbook
Designing cryogenic systems	JPR 1710.13, "Design, Inspection, and Certification of Pressure Vessels and Pressurized Systems," (current version) National Fire Protection Association Standards 50, "Bulk Oxygen Systems at Consumer Sites," 50B, "Liquefied Hydrogen Systems at Consumer Sites," and 59A, "Liquefied Natural Gas," and others, as applicable
Finding more data on cryogenic fluids	Attachments 6.5A – 6.5D, Appendix 6B
Finding requirements for electrical equipment you can use in areas with hydrogen	National Fire Protection Association Standard 70



# Chapter 6.6

## Underwater operations safety and health

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### ***This could be you . . .***

*A scuba diver was working upside-down for about 45 minutes when he noted a slight chest pain. The diver was treated for mediastinal emphysema and returned to diving after 2 weeks.*

*During a free-dive training exercise, a dive instructor suffered from shallow water blackout. A dive student retrieved the instructor from the pool bottom. Surface observers performed cardiopulmonary resuscitation on the dive instructor.*

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### **1. Applicability of this chapter**

You are required to follow this chapter if you operate or work with neutral buoyancy facilities, plan open water training, or use other non-open-water facilities.

### **2. What this chapter covers**

This chapter covers dive operation for open and non-open-water diving. It includes the following:

- a. Underwater testing and training
- b. Dive standards
- c. Requirements for divers, equipment, and breathing gases
- d. General operating procedures

### **3. Open and non-open-water diving**

For the purpose of this chapter, non-open-water diving is conducted in water that is in a manmade enclosure and is treated with chemicals.

### *Non-open water diving*

### **4. Steps to follow when using a neutral buoyancy facility**

As a test requester or operator, you shall:

- a. Follow Chapter 6.9, “Space systems and test safety,” of this handbook for training and testing operations in JSC neutral buoyancy facility (NBFs).
- b. Follow the requirements in NASA-STD-8719.10, “Standard for Underwater Facility and Non-Open Water Operations.”

## Part 6, Safety and health practices for certain hazardous tasks

- c. Develop a dive plan that includes the following at a minimum:
  - 1. Purpose of the test.
  - 2. Test objectives.
  - 3. Scope of the test.
  - 4. Test requirements.
  - 5. Safety and medical planning provisions.
  - 6. Any known medical issues.
  - 7. Any special precautions or safety considerations.
  - 8. Method of testing.
  - 9. Other items that might be required by the NBF you are using.
  - 10. The NBF's critical lift procedures.

The NBF may have more requirements than those listed here.

### *Open water diving*

#### 5. Requirements for open water operations

If you, as a test requester, are involved with human open-water testing or training, you make your management, the Safety and Test Operations Division, and the Clinical Services Branch aware of your intentions.

#### 6. Standards for open water operations

You shall:

- a. Follow 29 CFR 1910, Subpart T, "Commercial Diving Operations."
- b. Develop alternate standards if your operations involve unique equipment and methods not addressed by OSHA. These standards shall be:
  - 1. Developed by the responsible line management.
  - 2. Based on consensus standards.
  - 3. Approved as described in Chapter 1.4, "Written Safety and Health Program," of this handbook.

*Other requirements that apply to open and non-open water diving*

**7. Using the “buddy system”**

As a diver, you shall use the “buddy system.” Never dive alone unless all of the following are true:

- a. There is an emergency and someone’s life is in danger.
- b. You volunteer for the rescue. No one may force you.
- c. You are in direct visual contact or are tethered.

**8. Medical requirements for dive team members during a test**

You shall have a medical examination:

- a. At least yearly by a doctor who knows the hyperbaric conditions that you will encounter, your mode of diving, and what type of work you will be doing. If you are a guest diver, you shall have an examination at least every 3 years.
- b. Before diving.
- c. If you are injured or become ill and have to be hospitalized for more than 24 hours.
- d. At the attending doctor’s discretion.

**9. Training for dive team members**

You need to be certified as described in Chapter 5.8, “Hazardous operations: safe practices and certification,” of this handbook. Your formal training shall include the following:

- a. The use of the tools, equipment, and systems that you will use.
- b. Techniques and procedures of the assigned diving modes, including the buddy system concept and open water communication.
- c. Diving operations, including diving-related physics and physiology.
- d. Emergency procedures, including cardiopulmonary resuscitation and first aid for lifeguards only.

**10. Minimum requirements for breathing gases and diving equipment**

Breathing gases and equipment used in NBFs shall meet these minimum requirements of Chapter 6.13, “Safety and Health Requirements for Ground-Based Breathing Gases and Breathing Gas Systems,” of this handbook. Document and correct all discrepancies that you find in the equipment before you use it on any more dives.

## Part 6, Safety and health practices for certain hazardous tasks

### 11. Electrical equipment for underwater use

You shall follow these requirements for electrical equipment used underwater:

- a. Tools and underwater equipment shall meet the minimum electrical requirements contained in ~~this section~~ paragraph 5.3.3 of NASA-STD-8719.10, ~~or be accepted for use by an ad hoc committee composed of representatives of the Center's safety, underwater facility line management, medical, and electrical engineer with bio-electrical experience. The special ad hoc committee:~~
  - ~~1. Shall assess the shock hazard, recommend controls to reduce or eliminate the hazard, and discuss the risk associated with any remaining hazards.~~
  - ~~2. Shall present its results to the appropriate Test Readiness Review Board (TRRB) for approval.~~
- b. ~~You are responsible for safeguard batteries used underwater to prevent hydrogen outgassing, and packaging them to prevent chemical leakage into the water or electric short circuits from water leaks.~~
- c. ~~You shall protect personnel from exposure to any electrical hazard that can result in injury, created by underwater tools and equipment, by at least two independent verifiable controls. Controls need to be verified operational before use. The potential for exposure to electric currents greater than or equal to 6.0 milliamperes represents a potential electric hazard.~~
- d. ~~The special ad hoc committee mentioned in subparagraph 11.a above shall review tools, equipment, or systems using greater than 30 volts (alternating current (AC) (root mean square), direct current (DC), or combination) and present the results to the TRRB for approval before use in the underwater facility. Tools and underwater equipment limited to 30 volts or less (AC (rms), DC, or combination thereof) that include a verifiable barrier to electric shock are not normally considered potentially hazardous.~~
- e. ~~b.~~ You shall install listed ground fault circuit interrupters in the branch circuit supplying underwater lighting fixtures operating at more than 15 volts AC so that there is no shock hazard during re-lamping.
- f. ~~c.~~ Areas around the pool that are subject to saturation with water or other liquids shall be considered "wet area locations" and protected with listed ground fault circuit interrupters in the branch circuits.

### 12. General operating procedures

If you oversee any diving operations, you need to have a "safe practices manual" available to each dive team member at the open water dive location. The manual shall include standards, general information, requirements, and:

- a. Specific procedures and checklists for each diving operation. See paragraph 14 below for minimum requirements.

## Chapter 6.6, Underwater operations safety and health

- b. Responsibilities of the dive team members and support personnel.
- c. Equipment procedures and checklists.
- d. General emergency procedures, including rescue techniques and medical treatment.

### 13. What the general operating procedures need to cover for each dive phase

Follow these requirements:

- a. The pre-dive phase shall include:
  - 1. Planning the dive.
  - 2. Assessing the safety of the dive.
  - 3. Identifying and inspecting equipment and supplies.
- b. The dive phase shall include:
  - 1. Entering and exiting the water.
  - 2. Communications between divers and surface personnel.
  - 3. Dive profiles and limits.
  - 4. Individual and crew responsibilities.
  - 5. Decompression tables as appropriate.
  - 6. Tools and equipment.
  - 7. Use of hazardous materials.
  - 8. Dive termination under normal and emergency conditions.
  - 9. Use of support and rescue equipment.
- c. The post-dive phase shall include:
  - 1. Checks on physical conditions of the divers.
  - 2. Other precautions necessary following the dive.
  - 3. Preparation of records of the dive.
  - 4. Records of equipment malfunctions.
  - 5. If required, assessment of recompression capability and decompression procedure.

### 14. Pre-dive briefing

Before the dive you need to have a diver and crew briefing by a person familiar with the safety requirements and operational aspects of the dive. The briefing shall include a review of the following:

- a. The applicable portions of the safe practices manual.

## Part 6, Safety and health practices for certain hazardous tasks

- b. The specific operating procedures and individual diver and responsibilities.
- c. Dive profiles and operational limits.
- d. The buddy system (no one dives alone), assignments of pairs, and communications.
- e. Emergency and rescue procedures and responsible personnel.

### 15. Records

You shall keep the following records, make copies available for employees to review, and protect them under the Privacy Act of 1974:

- a. Records, reports, and other documents pertinent to the safety and health of employees in open water operations. You shall prepare and maintain them under an established schedule that includes at least the requirements in OSHA 29 CFR 1910.440, "Record Keeping Requirements."
- b. Breathing air records, such as sampling and analysis results.
- c. Records of all maintenance on the diving equipment and support apparatus.
- d. Records of all materials used in an oxygen-enriched environment if enriched gas mixtures are used.

### 16. Responsibilities for underwater safety

The following have responsibilities for underwater safety:

- a. If you are a *line manager*, you are responsible for making sure that the regulations in this handbook and applicable OSHA regulations are met.
- b. The *Safety and Test Operations Division* is responsible for:
  - 1. Making sure that human testing, training, or preparations follow the regulations in this handbook, applicable OSHA regulations, and approved procedures.
  - 2. Monitoring all suited subject testing or training. The Safety and Test Operations Division may decide to monitor other testing or training.
  - 2.3. Audit JSC NBFs yearly for compliance with this chapter and NASA-STD-8719.10 as described in paragraph 5.4 of NASA-STD-8719.10 and based on current activities, critical areas, and significant risks..
- c. The *Medical Operations BranchSpace Medicine Division* is responsible for:
  - 1. Monitoring all human testing or training based on the requirements of NASA-STD-8719.10.
  - 2. Making sure that the people involved in open water operations meet the physical requirements to perform their duties.

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# Chapter 6.9

## Space systems and test safety

### 1. Applicability of this chapter

You are required to follow this chapter if you:

- a. Conduct or participate in testing activities at JSC or JSC field sites.
- b. Are involved in tests at other locations, foreign or domestic, including those with JSC equipment.

### 2. What this chapter covers

This chapter covers the basic safety requirements and references for all tests conducted at JSC, and for tests conducted at other locations that involve JSC personnel or property or that are sponsored by JSC. This chapter applies to equipment being tested, test personnel, test facility interfaces to test equipment and personnel, test conduct, and test documents. Test hardware and operations shall also follow the requirements of other chapters in this handbook. The term “testing,” as used in this chapter, includes hazardous activities designed to accomplish training, demonstrations of test hardware or procedures, data acquisition, and hardware evaluation, qualification, or acceptance.

### 3. Exclusions from this chapter

This chapter doesn't cover testing of institutional systems and equipment, diagnostic medical tests, or medical treatment procedures. (This exclusion doesn't apply to medical research testing.)

This chapter also excludes laboratory analysis, research, and experimentation that doesn't involve human subjects, flight hardware, prototype hardware, explosives, and oxygen-enriched atmospheres.

### 4. Requirements for test operations

You shall keep the Safety and Test Operations Division informed of upcoming test activities by a test request, schedule, or other means and follow these requirements:

- a. For nonhazardous tests, you shall follow paragraphs 5 and 9 through 11 (operating procedures, test systems, and test team members) of this chapter and any other requirements from this chapter that you or the Safety and Test Operations Division decide to include. Also make test documentation available to the Safety and Test Operations Division on request.
- b. For hazardous tests, you shall follow all the requirements in this chapter that apply to your tests. You or the Safety and Test Operations Division may also decide to follow more stringent requirements.

## Part 6, Safety and health practices for certain hazardous tasks

- c. Include the applicable requirements of this chapter in any requirements you provide to test requestors.

### *Test team requirements*

#### 5. Test team members

The following personnel shall be present during each test as required below or in other sections of this chapter. These personnel may not be required to be present throughout the entire test. The testing organization's operating procedures or detailed test procedures (DTPs) specify when each member is to be present.

<i>If you are the . . .</i>	<i>Your duties are . . .</i>	<i>Your certification requirements are . . .</i>
Test Director (TD)	To be the central authority and have overall responsibility for all aspects of the test.	The responsibility of the testing organization
Test Conductor (TC) (Optional)	Described in the testing organization's operating procedures or DTPs.	The responsibility of the testing organization
Test Safety Officer (TSO)	To monitor all phases of test activities for certain human or especially hazardous tests, and to advise the TD of any activities deemed to be hazardous to JSC personnel or property.  To advise the Safety and Test Operations Division of any safety concerns that surface during the test  To advise the Clinical Services Branch of any health concerns that surface during the test.	The responsibility of the Safety and Test Operations Division or the Clinical Services Branch
Medical Officer (MO) or Medical Representative (MR)	To monitor the test conduct, provide medical assistance or opinions when necessary, and advise the TD any time the wellbeing of anyone involved in the test is being compromised.	Defined by the Clinical Services Branch
Facility or Test Support Personnel  Facility or test support personnel include all other personnel necessary to support a test, such as console operators, divers, test article support personnel, audiovisual personnel, or pressure suit engineers	Listed in the testing organization's operating procedures, test plan, or DTPs.	Specified in the testing organization's operating procedures, test plan, or DTPs.

## Chapter 6.9, Space Systems and Test Safety

<i>If you are the . . .</i>	<i>Your duties are . . .</i>	<i>Your certification requirements are . . .</i>
Test Subject (the human subjected to the test environment)	Inform the TD if you feel that you maybe in danger and desire to stop the test.	Specified in the operating procedures, test plan, or DTPs.

### 6. Other requirements for test team members

You shall observe the following additional requirements if you are the MO or MR:

- a. As the MO, you shall certify the fitness of test team personnel to do hazardous operations and of test subjects to participate before any hazardous testing begins.
- b. An MR shall monitor the medical conduct of tests under the following conditions unless excluded by, and as deemed necessary by, the Clinical Services Branch:
  1. Personnel in hypobaric, hyperbaric, and oxygen-enriched environments.
  2. Suited underwater neutral buoyancy operations.
  3. Ambient pressure suit operations using other than ambient air or where the suit pressure is greater than 8.8 psid (pounds per square inch differential).
- c. As the MR or TSO, you shall:
  1. Keep in communication with the TD at all times when your presence is required during the test.
  2. Review test documentation and participate in TRRs as required.
  3. Make sure that there is adequate and functional bioinstrumentation on each test subject.
- d. As a TSO, you shall also review test and safety documentation for all tests conducted within your area of responsibility. You should attend test reviews as well.
- e. A TSO shall monitor the following tests:
  1. Personnel in hypobaric, hyperbaric, and oxygen-enriched environments.
  2. Suited underwater neutral buoyancy operations.
  3. Testing or training involving personnel at heights greater than 10 feet above the ground or on a platform.
  4. Ambient pressure suit operations using other than ambient air or where the suit pressure is greater than 8.8 psid.
  5. Suited subject testing on the precision air bearing floor, orbiter training mock-ups, and any other hazardous training.

## Part 6, Safety and health practices for certain hazardous tasks

### 7. Training and certification for test team members

If you are a team member or support person, you shall be trained for your job as described in your operating procedures. Never fill a position without being certified. See Chapter 5.8, “Hazardous operations: safe practices and certification,” of this handbook for more requirements on certification. See Chapter 4.1, “Program Description,” (for safety and health training) of this handbook and JPR 8550.1, “JSC Environmental Compliance Procedural Requirements,” for more requirements on training.

### 8. Operating procedures for testing

As a testing organization, you shall have ~~operating procedures that meet~~ operating procedures that follow paragraph 6 of Chapter 10.2, “Safety and health requirements for test, vacuum, and oxygen-enriched facilities,” of this handbook. The operating procedures may contain more stringent requirements than those of this handbook if you and the Safety and Test Operations Division believe they are required. ~~If you have no operating procedures, include the required information for operating procedures in your test plan or DTPs. The Safety and Test Operations Division must approve the safety assessment and DTPs.~~

## *Requirements for test systems*

### 9. Requirements for all test systems

The following requirements apply to all test systems, both hazardous and nonhazardous. You can find additional requirements in other chapters of this handbook:

- a. Test systems shall be designed and constructed so that a single-point failure, loss of utilities, fluctuation of utilities, or software command can’t cause injury, property damage, or uncontrolled environmental spill, release, noncompliance, or nonconformance. Follow reliability and fault-tolerance requirements in paragraph 1.7 of NPR 8715.3, “NASA General Safety Program Requirements.”
- b. Test systems used in oxygen-enriched, high-vacuum, or enclosed environments shall undergo materials scrutiny as defined by the testing organization’s material control process.
- c. The test system’s materials shall follow the material control requirements of Chapter 10.2 of this handbook if the facility does not have a materials control process.
- d. Safety and environmental instrumentation shall be calibrated and certified before the test and as required by the test documentation or the testing organization’s operating procedures.
- e. Test systems are approved for testing after the Test Readiness Review Board (TRRB), including the Safety and Test Operations Division has signed the TRRB approval sheet and all constraint action items are determined closed by the TRRB Chair (see paragraph

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## Chapter 6.9, Space Systems and Test Safety

- 13).
- f. Software that interfaces with test systems shall meet NASA-STD-8719.13, “Software Safety.”
- g. Make sure that no test team member can be exposed to hazardous materials used in the system.
- h. Clearly identify test controls in test and facility system drawings.

### 10. Requirements for tests systems involving human subjects

In addition to the requirements above, human test systems shall meet the following requirements:

- a. Have a means of immediately detecting an incipient fire or other hazardous condition in each occupied compartment of any test area. Automatic detection shall be provided for critical areas that are not suitable for visual monitoring.
- b. Be designed for rescue of an incapacitated test subject.
- c. Be designed for safe test termination and removal of test subjects if a power failure, fire, or other emergency occurs.
- d. Have software-controlling test systems ~~analyze~~evaluated to make sure no command can cause death or injury to test subjects.
- e. Provide manual overrides for software commands to ensure the safety of test subjects. The commands shall support safe test termination and egress of the test subject.

## *Test documentation*

### 11. Documentation requirements for tests

You shall complete the following documentation as part of the test process. Complete everything but the test report and the mishap report before the test:

- a. The **test plan** is a top-level summary of the test. A test plan needs to be written for each new test. The test plan shall include the following as a minimum:
  - 1. Test objectives.
  - 2. Safety, occupational health, and medical planning provisions and known medical issues.
  - 3. Test requirements.
  - 4. Special safety, occupational health, and environmental considerations for test.
  - 5. Other items, if required by the testing organization; test plans containing final DTPs (as described below) shall be approved in the same manner as a DTP document.

## Part 6, Safety and health practices for certain hazardous tasks

- b. The **DTP** describes the steps you will use to run the test. ~~You should make the test procedures available for critical review at least 3 to 5 days before the TRR.~~ You need to write test procedures in a step-by-step sequential format. DTPs shall include the following as a minimum:
1. Operating procedures to accomplish the test.
  2. Measures to prevent mishaps.
  3. Emergency procedures to be taken in the event of systems failure or malfunction such as fire, smoke, power outages, environmental spills and releases, and system failure.
  4. Test rules which define equipment and instrument limits, operating limits, off-nominal conditions, and operational situations that would require abort, hold, or proceed decisions for each test or checkout operation.
  5. The safety requirements, individual tasks, and personnel involved in hazardous operations.
  6. Special considerations and procedural steps that address specific hazards identified during the hazard analysis process; these, and steps containing actions critical to the protection of life or property, shall be flagged as safety-critical steps for easy identification by test team personnel.
- c. A **safety, health, and environmental assessment** that identifies the safety and health hazards associated with the test, the hazards' controls, and verification. Your operating procedures shall outline the assessment process and identify specific assessment subjects. The process should begin in the early phases of test planning and operations and should involve the Safety and Test Operations Division and the Clinical Services Branch at every step. Eliminate, control, or close all hazards, or accept the risk before testing begins:
1. Your operating procedures state how you document the results of safety and health assessments. You shall update your assessments for changes to the hardware or operations.
  2. Chapter 2.4, "Hazard Analysis," of this handbook describes system safety requirements and concepts. This includes an environmental impact assessment as described in JPR 8553.1, "JSC Environmental Management System Manual." You may use JSC 17773, "Instructions for Preparing Hazard Analysis for JSC Ground Operations," as a guideline for format or thought process for conducting safety assessments. Other information sources on safety assessments include MIL-STD-882, "System Safety Program Requirements," and Chapter 2 of NPR 8715.3, "NASA General Safety Program Requirements."
- d. If you prepare a **test report**, you should include any anomalies; safety, health, or environmental implications; and safety or health lessons learned. Send a copy of the report to the Safety and Test Operations Division and the Clinical Services Branch. You may send lessons learned by means other than the report.
- e. You shall send in a **mishap report** for any incident causing ~~damage~~, injury, ~~or unapproved~~ environmental spill or release, or unanticipated damage to the test article or test system

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## Chapter 6.9, Space Systems and Test Safety

~~that occurred as the result of the test. any~~ Submit a close call report if an incident occurred that could have caused ~~damage~~, injury, ~~or unapproved~~ environmental spill or release, ~~or unanticipated damage to the test article or test system (a close call)~~. See Chapter 2.7, “Mishap and Incident Investigation,” of this handbook for mishap reporting requirements.

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### 12. Requirements for certain test documents

~~To allow for a proper review, you shall provide the minimum required test documentation (Test Hazard Analysis, Test Plan, Detailed Test Procedure) to Test Safety at least 48 hours before the TRR. Incomplete or late submissions will require rescheduling of the TRR (see paragraph 15.b of this chapter for special exemptions). You should give the reviewers 3 to 5 days to carefully review the test documentation before the TRR. The more complex the test, the more time you should give them (see paragraph 15.b of this chapter for special cases).~~ You shall ~~also~~ follow these rules:

- a. Each DTP containing safety-critical steps shall state that on its cover.
- b. Emergency procedures shall be immediately available to personnel at their duty stations unless it isn't practical (such as divers).
- c. You shall have the Safety and Test Operations Division ~~signe~~~~neur on the Test Hazard Analysis DTPs.~~ The Safety and Test Operations Division representative's signature on the TRRB summary sheet shall indicate that other test documentation is approved for testing.

## *Operations requirements*

### 13. Test readiness reviews

The following requirements apply to TRRs:

- a. You shall hold a TRR for each test involving human subjects and for other hazardous tests or series of tests. An annual TRR is acceptable for an undefined number of tests where the tests are similar, involve no significant changes to the hardware, are low risk (RAC 4 with the concurrence of the Safety and Test Operations Division), and are individually approved by the branch chief. A TRR determines:
  1. The readiness of the test facility and the test article.
  2. The adequate completion of the safety, health, and environmental assessments.
  3. The status and closure of key issues.
  4. The test constraints.
  5. The open items.
  6. The qualification or certification of the test team.
- b. The TRRB will be chaired by a management official or designee from the testing organi-

## Part 6, Safety and health practices for certain hazardous tasks

zation who is not personally involved with the test. The board membership will include:

1. A Safety and Test Operations Division ~~Occupational Safety Group~~ representative.
  2. An Occupational Health, Medical, or Industrial Hygiene representative (as appropriate) from the Clinical Services Branch.
  3. A ~~Safety and Test Operations Division~~ Quality and Flight Equipment Division Assurance Group representative (for tests supported by the Quality and Flight Equipment Division Assurance Group).
  4. An Environmental Office Representative (if appropriate).
  5. Other members who might be selected by the board chairman or the testing organization for their special knowledge.
- c. The TRRB members will sign a TRRB summary sheet to indicate their approval to proceed with your test pending closure of all constraint action items as determined by the TRRB Chair. A TRRB summary sheet generally will include:
1. The test objective.
  2. A statement covering test article readiness.
  3. The test schedule.
  4. Approval of the staffing, operation, procedures, and safety, health, and environmental assessments.
- d. A TRR shall assess hazards of all hardware and procedures involved in the test to include:
1. Other procedures that are embedded in the test protocol, such as standard assessments.
  2. The rationale for approval of previously approved test protocols to determine whether they are still valid.
  3. Procedures that were developed for operational use and are being adopted for test use to determine whether they are appropriate for a test environment.

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## 14. Other test reviews

You shall have the following reviews unless they are indicated as “optional.”

- a. A **pre-test briefing** conducted by the TD or TC for each series of tests. The intent is to make sure that all test team members understand the test’s normal and emergency operations and all test hazards.
- b. **Pre-test checkout** operations, using approved test procedures. You need to conduct this before each series of tests to make sure that the test personnel will function effectively as a team and that the facility and test equipment are compatible. Your pre-test checkout operations shall include:
  1. Verification that all critical systems are functional.



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2. A “dry run” for complex tests, if practical, to exercise the facility and equipment for final compatibility and provide training and familiarization for the test team.
3. Simulated emergency drills unique to the specific test.
- c. A **post-test debriefing** (optional) by the TC or TD for human or complex tests. The intent is to discuss the test results and any facility or test system anomalies that have occurred with the test team and subjects (if appropriate).

### 15. Repeat, real-time, and quick-turnaround tests

You shall follow these requirements:

- a. You may repeat a test using previously approved configurations and procedures without another TRR as long as the test complies with the constraints of the original TRR and the paperwork has not changed. Modifications to the hardware or procedures will require a new TRR. Retests, modified procedures, and safety analyses shall be approved as described in your testing organization’s operating procedures.
- b. Real-time and quick-turnaround testing refers to testing that is required in real time to support a mission or pre-mission testing for a space mission. This testing is essential for timely start or safe continuation of the mission. For this type of testing, you may streamline the test process. As a minimum:
  1. You shall have test procedures and a hold TRR.
  2. You shall notify the Safety and Test Operations Division of such tests as soon as possible.
  3. A Safety and Test Operations Division representative shall be present for any procedure reviews, the TRR, and the test, if required.

### 16. Requirements for all test operations

You shall follow these requirements during any phase of test operations, both hazardous and nonhazardous, including buildup and teardown:

- a. Follow limits on work shifts for test team members and personnel supporting tests found in Chapter 5.8, “Hazardous operations: safe practices and certification,” of this handbook.
- b. Keep test data records ~~such as voice and video tapes, or computer tapes~~ for at least 14 days after the test to help investigation and analysis of any mishaps or anomalous conditions. Safety may require keeping the records longer.
- c. Follow the approved procedures. Each Testing Organization shall have a form for Test Deviations.
- d. You shall document deviations from approved procedures on a deviation sheet. Deviations sheets require signature approved by the Safety and Test Operations Division

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if the deviation affects hazard closure or creates a new hazard.

- e. The TD and any appropriate engineers shall approve the deviation by signature along with the TSO and MR, if on station for the test. *Never make deviations from test rules during the test.*
- f. Make sure that the TD maintains voice contact with all critical test team members. Communication requirements shall be specified in your operating procedures, test plans, or test procedures.
- g. Follow these requirements as a TD:
  - 1. Redirect the test to a safe position or stop the test if advised to stop the test by a TSO. You may resume the test after you resolve the safety issues with the TSO.
  - 2. Follow the MR's direction if the MR declares a medical emergency, following established procedures.
  - 3. Give the TSO access to any area of the test facility whenever the TSO deems it necessary, provided the TSO is present, it doesn't create any additional hazard, and the TSO is certified for the environment after coordinating with the TD.

## 17. Requirements for tests involving human subjects

In addition to the requirements in paragraphs 5 through 16, test operations involving human subjects shall meet the following:

- a. Keep in voice and visual contact with test subjects. Provide backup voice communications if feasible. Deliberate loss of voice or visual (but not both simultaneously) communications as part of a test is allowed if you document it in the approved test procedures.
- b. Equip rescue crews for tests with protective equipment suitable for the specific hazards of that test, such as breathing apparatus.
- c. Keep a hyperbaric treatment chamber on standby during the following test operations with human subjects:
  - 1. Pressure-suited operations in a vacuum or underwater environment.
  - 2. Ambient pressure suit operations where the suit pressure is greater than 8.8 psi above ambient.
- d. Have an MO certify the fitness of each test team member to test subjects doing hazardous operations before a test.
- e. Stop the test when a test subject requests that the test be discontinued.
- f. Use instruments on test subjects to monitor the critical physical parameters that the MO requires.
- g. Make sure appropriate emergency medical treatment is available, alerted, and on call.

## 18. Requirements for certain kinds of tests

Some tests need to meet other requirements besides those addressed in this chapter because of the hazards or the nature of the tests. Tests not covered here or by other chapters of this handbook should be coordinated with the Safety and Test Operations Division and the Clinical Services Branch at the earliest possible time to develop specific requirements in a timely manner. The following test operations shall follow these requirements:

- a. You shall observe the following additional requirements for *hypobaric tests* at pressures below normal atmospheric pressure:
  1. Follow JPD 8080.4 (current version), “Exposure to Reduced Atmospheric Pressures,” for hypobaric tests involving human subjects.
  2. Monitor the oxygen level if the test isn’t approved for an oxygen-enriched atmosphere. Stop the test if the atmosphere becomes oxygen-enriched.
  3. Maintain internal suit pressure at predetermined levels above ambient during pressure-suited operations.
  4. Take measures to prevent corona discharge.
- b. You shall observe the following additional requirements for *hyperbaric tests* at pressures above normal atmospheric pressure:

<b>Note:</b> This paragraph doesn’t apply to hyperbaric medical treatment.
--

1. Monitor the oxygen level if the test isn’t approved for an oxygen-enriched atmosphere. Stop the test if the atmosphere becomes oxygen-enriched.
  2. Follow exposure times and decompression stops in the Navy Dive Tables or more stringent tables using equivalent pressure depth.
  3. Never expose anyone who has been exposed to hyperbaric environments to any hypobaric conditions such as flying or altitude chambers for at least 12 hours after the hyperbaric exposure unless the subject has pre-breathed for a specified time according to JPRD 1830.3.
- c. For *underwater neutral buoyancy operations*, you shall meet and follow the following requirements and the requirements found in Chapter 6.6, “Underwater operations safety and health,” of this handbook:
  1. JSC neutral buoyancy operations are considered non-open-water operations that need to meet the requirements of Chapter 6.6 of this handbook by the individual facility operating procedures.
  2. You shall meet requirements for oxygen-enriched environments if other than ambient air oxygen percentage is used in the suit or if the differential suit pressure exceeds 8.8 psi.
  3. All underwater personnel shall observe the restrictions on flying after diving of JPRM 1830.3 (current version), “Limitations Applicable to Personnel Exposed to Diving.”

## Part 6, Safety and health practices for certain hazardous tasks

4. Never require pressure-suited subjects to walk.
- d. You shall use fall protection if personnel involved are at a height greater than 4 feet.
- e. Physiological training shall follow the requirements for hypobaric tests listed above. A TSO needn't be present during all physiological training runs. ~~A TSO monitors each type of physiological training profile yearly.~~
- f. The requirements of subparagraph b above also apply to ambient **pressure suit operations**, except that suits using ambient air at pressures less than 8.8 psid aren't considered oxygen enriched. You shall follow procedures or lesson plans for testing or training, or demonstrations involving personnel in pressure suits at ambient conditions.
- g. You shall develop handling procedures to protect high-cost and mission-critical **flight hardware**. Have new or modified procedures approved before handling the hardware.
- h. You shall meet the following additional requirements for test systems flown on JSC **zero-gravity aircraft**:
  1. Avoid hazardous materials including high-pressure gases, toxic, corrosive, explosive, and flammable materials where possible. If such materials are necessary, use proper containment. You may also require provisions for dumping and purging in flight to include minimizing or controlling impact to the environment.
  2. Never use wet cell batteries with free electrolyte such as lead acid car batteries. Battery circuits require analysis by battery experts and battery circuit safety protection to avoid shock, shorts, or overheating.
  3. The maximum total volume of inert gases or gases you may use on a flight is limited to one K-bottle ( $\approx 200 \text{ ft}^3$  @ 14.7 psi).
  4. Airworthiness is determined by the JSC Aviation Safety Officer and the Aircraft Commander.
  5. Follow the laser requirements in paragraph 3.15.7 of NPR 8715.3 if lasers are used.
- i. Tests on **air-bearing floors** involving moving articles pose a threat of injury to personnel involved in the test. You shall take appropriate measures to prevent the impact of moving objects with personnel.
- j. **Human research testing** shall follow NPD 7100.8, "Protection of Human Research Subjects," and 45 CFR 46, "Protection of Human Subjects."
- k. When you work in direct view of a bare (pressurized arc) lamp of a **solar simulator**, you shall wear eye and skin protection.
- l. Tests involving lasers shall have approval and monitoring from the JSC Laser Safety Officer. See Chapter 6.2 of this handbook for more requirements.
- ~~l-m. Tests involving biological materials shall have an assessment by the JSC Biosafety Review Board per JSC 63828 "Biosafety Review Board Operations and Requirements Document" to ensure the appropriate facility controls, PPE, and proper handling techniques are implemented. See Chapter 7.4 of this document for additional~~

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## Chapter 6.9, Space Systems and Test Safety

[information on biosafety.](#)

### 19. Off-site tests

JSC safety requirements still apply if you perform your testing off site at any foreign or domestic location. You shall follow the requirements in paragraph 20 for any one of the following:

- a. Off-site tests sponsored by JSC.
- b. Off-site tests involving JSC personnel as test subjects.
- c. Off-site tests involving JSC high-cost and mission-critical hardware.

### 20. Requirements for off-site tests

If you or your organization sponsors an off-site test, you shall:

- a. Make sure, with help from the Safety and Test Operations Division, that the intent of these requirements is met either by the test site or by JSC. The JSC sponsor shall notify the Safety and Test Operations Division of the test at the earliest possible time. New facilities or new applications in existing facilities will require more scrutiny by JSC than established facilities and operations.
- b. Make sure that the safety requirements of the test site are followed. JSC may require that the applicable provisions of this chapter be followed in addition to the test site requirement(s).
- c. Provide the following additional data to the Safety and Test Operations Division as needed:
  1. Test site safety requirements and a safety point of contact from the testing organization.
  2. Existing test facility documentation such as drawings, specifications, hazard analyses, operating procedures, and emergency procedures necessary for an adequate review, if available.
- d. Make sure that a TD or equivalent will be in charge of the test at all times. The TD may be from JSC or the testing organization.
- e. Coordinate access by the Safety and Test Operations Division personnel to all test areas. The Safety and Test Operations Division shall:
  1. Review and concur on the test setup.
  2. Coordinate JSC safety and medical monitoring with the Medical Operations Branch, as required.

## Part 6, Safety and health practices for certain hazardous tasks

### 21. Test readiness reviews and facility reviews for off-site tests

The following requirements apply:

- a. If a TRR is held at JSC, it will be chaired by a JSC management official who is not personally involved with the test.
- b. A specially appointed JSC committee may review an off-site test facility and operations, and then grant approval for JSC participation via a letter for off-site facilities where testing with JSC personnel or hardware will occur on a regular basis. JSC may hold an operational readiness inspection for the facility and grant approval. JSC personnel and hardware may be involved in operations at approved facilities that follow the conditions of JSC approval. Modification of the facility or operating procedures will require JSC review before resuming operations with JSC personnel or hardware.

### 22. Off-site users of JSC test facilities

Personnel from other NASA centers, NASA contractors, and others often use JSC test facilities. Off-site users shall follow this chapter and the testing organization's operating procedures.

### 23. For more information on testing

- a. 29 CFR 1910, Occupational Safety and Health Association, "Occupational Safety and Health Standards, General Industry," applicable subparts
- b. JPR 1710.13 (current version), "Design, Inspection, and Certification of Pressure Vessels and Pressurized Systems"
- c. JPR 5322.1, "Contamination Control Requirements Manual"
- d. JSC 09331, "The Prevention of Electrical Breakdown and Electrostatic Voltage Problems in the Space Shuttle and its Payloads" (parts I and II provide guidelines on corona and its prevention)
- e. National Fire Protection Association Standard 70, "National Electric Code"
- f. Other appropriate standards such as NFPA, American Society for Testing and Materials (ASTM), ANSI, etc.
- g. Individual JSC test facility operating procedures and safety plans
- h. Paragraph 3.14 of NPR 8715.3, "NASA General Safety Program Requirements"

### 24. Responsibilities for test safety

- a. **Testing organizations** are responsible for:
  1. Ensuring compliance with facility safety, health, test, environmental, and operational requirements.

## Chapter 6.9, Space Systems and Test Safety

2. Maintaining personnel and facility documentation as required by this chapter and Chapter 10.4, “Facility baseline documentation requirements for hazardous or critical facilities,” of this handbook.
  3. Informing the Safety and Test Operations Division of planned test activities by a mutually agreed method as per paragraph 5.3 of this chapter.
  4. Informing directorate-level management of any additional risks before starting each new or nonroutine test or test series, where there is the potential during test operations for serious injury, loss of life, environmental spill or release, or loss of critical high-dollar-value hardware.
  5. Making sure that potential environmental impacts have been considered before or during the TRR, and coordinating with the Environmental Office as needed.
- b. **Test requesting organizations** are responsible for following test and facility safety, health, and environmental requirements and for preparing and submitting test documentation required by your operating procedures.
- c. The **Clinical Services Branch** is responsible for:
- Providing medical support, surveillance, and monitoring as required by paragraph 4 of this chapter.
  - Providing industrial hygiene support as required.
  - Making sure that appropriate emergency medical treatment facilities are available.
- d. The **Safety and Test Operations Division** is responsible for:
- Making sure that a program is implemented to provide a safe and healthful workplace for test operations and test team personnel, and protecting government resources from loss, damage, and destruction.
  - Helping testing organizations, test requesting organizations, and resident Quality Assurance, Reliability, and Safety Offices (QARSOs).
  - Providing safety surveillance via a certified TSO as required by paragraph 5 of this chapter.
  - Reviewing and critiquing test equipment designs and documents to ensure appropriate safety requirements are included.
  - Providing concurrence on hazardous test operations.
  - Making sure that mishaps and anomalies are investigated, that results are reported to appropriate offices, and that proper controls are in place to prevent recurrence.
  - Providing Safety Technical Expertise to the Committee for the Protection of Human Subjects.
  - [Follow paragraph 1.14.2.b of NPR 8715.3 for offsite tests in paragraphs 19 – 21 of this chapter](#)

## Part 6, Safety and health practices for certain hazardous tasks

e. *Resident QARSOs* are responsible for:

- Coordinating with, and fulfilling the responsibilities of, the Safety and Test Operations Division at JSC remote sites.
- Developing local test safety requirements and procedures that follow this chapter and Chapter 10.2 of this handbook.

f. The *Committee for the Protection of Human Subjects* is responsible for:

- Reviewing and approving all test plans where human research is involved per NPD 7100.8 (current version), “Protection of Human Research Subjects.”
- Reviewing the safeguards of tests involving hazardous materials, where human test subjects or the test team may be exposed to those materials.



# Chapter 6.10

## Entering confined spaces and controlled areas

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### *This could be you . . .*

*Three technicians died in a confined space that contained nitrogen. The first one passed out and died when he entered the space. The other two passed out and died trying to rescue him.*

*A technician was working in a chamber that was not a confined space and encountered an oxygen-deficient atmosphere after climbing a ladder to a higher level. The technician lost consciousness and fell from the ladder.*

---

### 1. Applicability of this chapter

You are required to follow this chapter if you:

- a. Do or oversee any work that involves entering confined spaces or controlled areas at JSC.
- b. Have a confined space or controlled area in your work areas as a facility manager or line manager.
- c. Do any of the above work at WSTF; you are required to follow WSTF procedures and requirements for entering confined spaces or controlled areas and use WSTF forms that meet the intent of this chapter.

### 2. What this chapter covers

This chapter contains JSC requirements for safely entering confined spaces that meet and exceed those in 29 CFR 1910.146, "Permit-Required Confined Spaces." Paragraphs 28 – 31 cover controlled areas.

### *Defining and classifying confined spaces*

### 3. What is a confined space?

A confined space is one that meets all of the following criteria:

- a. An employee can completely enter and work in the space.
- b. The space has limited or restricted entries or exits.
- c. The space isn't designed for continuous employee occupancy.

## Part 6, Safety and health practices for certain hazardous tasks

Examples of confined spaces include tanks, vessels, silos, storage bins, hoppers, vaults, and pits. Hazards of confined spaces include possible asphyxiation; explosions; poisoning from toxic vapors; slips, trips, and falls; and mechanical and electrocution hazards.

### 4. Classifying a confined space at JSC

All confined spaces at JSC have entry permit requirements. JSC has two classes of confined spaces: JSC permit-required confined spaces and OSHA permit-required confined spaces. Paragraphs 5 and 6 below define these spaces. The Safety and Test Operations Division, the Clinical Services Branch, and certain line organizations have classified confined spaces using these definitions. The Clinical Services Branch keeps a list of JSC's confined spaces and their normal classifications. Confined space locations and classification may change as facilities and operations change.

The following requirements apply to identifying and classifying confined spaces:

- a. JSC and WSTF shall evaluate their work areas to identify and classify confined spaces.
- b. You shall classify a confined space based on its normal use. The work to be done in a confined space may change its normal classification.
- c. You shall reclassify a JSC permit-required space as an OSHA permit-required confined space if the work to be done increases the hazard in the space. Examples include welding, chemical use, radiography, and painting.
- d. You may reclassify an OSHA permit-required confined space as a JSC permit-required confined space if you can eliminate the hazards without entering the confined space. This reclassification is only valid for as long as the hazards remain eliminated for that entry.

### 5. JSC permit-required confined spaces

A JSC permit-required confined space is a confined space that doesn't contain or, with respect to atmospheric hazards, have the potential to contain any hazard capable of causing death or serious physical harm~~have and won't have any potential to cause death or serious physical harm to anyone entering the space.~~

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### 6. OSHA permit-required confined spaces

An OSHA permit-required confined space is one that has one or more of the following characteristics. The space:

- a. Contains, or has the potential to contain, a hazardous atmosphere that may expose employees to the risk of death, incapacitation, impairment of ability to self rescue, injury, or acute illness from one or more of the following causes:
  1. Flammable gas, vapor, or mist in excess of 10% of its lower explosive limit (LEL).
  2. Airborne combustible dust at a concentration that meets or exceeds its LEL.

## Chapter 6.10, Entering confined spaces and controlled areas

3. Atmospheric oxygen concentrations below 19.5% or above 23.5%.
4. Atmospheric concentration of any substance for which there is a published PEL and which could result in employee exposure in excess of its dose or PEL.
5. Any other atmospheric condition that is immediately dangerous to life or health.
- b. Contains a material that could engulf an entrant.
- c. Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor that slopes downward or tapers to a smaller cross section.
- d. Contains any other recognized serious safety or health hazard.

### 7. What to do if you have confined spaces in your work area

If you, as a facility manager or line manager, have an OSHA permit-required or a JSC-permit required confined space in your work area, you shall follow these rules:

- a. For an OSHA permit-required space, you shall:
  1. Inform exposed employees, by posting danger signs or by any equally effective means, of the existence and location of and the danger posed by the OSHA-permit spaces.
  2. Lock or bolt the space by a mechanical means.
  3. Post or stencil this sign on all entrances if you can't lock or bolt the space (contact Clinical Services Branch at x34317 for signs and stencils):

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**DANGER CONFINED SPACE, NO ENTRY WITHOUT  
PROCEDURE AND PERMIT**

- b. JSC-permit required spaces shall be labeled with the following sign:

**DANGER CONFINED SPACE, NO ENTRY WITHOUT  
PROCEDURE AND PERMIT**

### *Requirements for entering confined spaces*

### 8. Requirements for entering any confined space

Carefully plan and control work in a confined space to prevent death or serious injury. Ideally, you should eliminate the hazards in a confined space before entering it. If you can't eliminate the hazards, control them with PPE or other measures. You shall follow these requirements for entering any confined space:

- a. Have the following before you enter any confined space:

## Part 6, Safety and health practices for certain hazardous tasks

1. An approved and posted written procedure as described in paragraph 13 of this chapter.
  2. An approved and posted entry permit as described in paragraph 14 of this chapter.
  3. Confined space training.
- b. Never enter a confined space until you have assessed the hazards, met the requirements in this chapter, and have a permit that authorizes you to enter.
  - c. Carefully examine any work you will be doing in the space to make sure it doesn't increase hazards. If your work will increase the hazards in a JSC permit-required confined space, you shall upgrade the classification to an OSHA permit-required confined space.
  - d. Only allow the minimum number of people necessary to do the job in or around a confined space.
  - e. You may downgrade an OSHA permit-required confined space to a JSC permit-required confined space if you can eliminate the hazards in the space without entering it. You shall document that you have eliminated the hazards on your entry permit. Ventilate the space for 30 minutes before testing the atmosphere. Continue ventilation while people are in the space. See subparagraph 16a of this chapter for more details.

## 9. Requirements for entering a JSC permit-required confined space

- A JSC permit-required confined space is defined in paragraph 5~~one that does not have, and will not have, any potential to cause death or serious physical harm to anyone entering the space.~~ In addition to the procedure and permit, you shall follow any of these requirements that apply to the space or to the work you will be doing:
- a. Follow your current, approved procedure and all conditions on your permit.
  - b. Use lockout/tagout to isolate any energy sources. See paragraph 17 of this chapter for more details.
  - c. Eliminate any conditions that make it unsafe to remove any entrance cover before you remove it.
  - d. Ventilate the space for 30 minutes or as specified in the procedures. Continue ventilation while people are in the space. See subparagraph 16.a of this chapter for more details.
  - e. Do not enter the space until atmospheric testing shows:
    1. Oxygen levels are between 20.5% and 21.5 %.
    2. Explosive atmospheres are 0% of the LEL.. (See subparagraphs 16b, 16c, and 16d of this chapter for more details.)
  - f. Use at least one attendant. See paragraph 19 of this chapter for more details.
  - g. Restrict access with barriers and tape. See subparagraph 21.f of this chapter for more details.

- h. Wear hard hats when required. See paragraph 22 of this chapter for more details.
- i. Make sure that you have communications with those in the space and a method to call for emergency services. See subparagraph 21.c of this chapter for more details.
- j. Contact the Occupational Health Department at x36726 if you have any questions.

#### **10. Requirements for entering an OSHA permit-required confined space**

In addition to having an approved procedure and permit, you shall:

- a. Follow your current, approved procedure and all conditions on your permit.
- b. Notify the Emergency Operations Center at x34658 and the Occupational Health Department at x36726 that you are entering an OSHA permit-required confined space.
- c. Use lockout/tagout to isolate any energy sources. See paragraph 17 of this chapter for more details.
- d. Eliminate any conditions that make it unsafe to remove any entrance cover before you remove it.
- e. Ventilate the space for 30 minutes before testing the atmosphere. Continue ventilation while people are in the space. See subparagraph 16.a of this chapter for more details.
- f. Test for a high- or low-oxygen level, explosive atmosphere, and toxic gas or vapor as specified in the procedure before entering the space. Verify that:
  - 1. Oxygen levels are between 20.5% and 21.5%.
  - 2. Explosive atmospheres are 0% of the LEL.
  - 3. Toxic vapor levels meet the concentration levels specified in the confined space procedure.(See subparagraphs 16b, 16c, and 16d of this chapter for more details.)
- g. Use the following equipment:
  - 1. Body harnesses, lifelines, and a hoisting or lifting device. Use wristlets for overhead and small openings. See paragraph 23 of this chapter for more details.
  - 2. Required PPE, including hard hats. See paragraph 22 of this chapter for more details.
  - 3. Intrinsically safe lighting and tools. See subparagraphs 17.c and 17.d of this chapter for more details.
- h. Have an attendant and entry supervisor present. The supervisor may leave the space if he or she isn't also the attendant. See paragraphs 18 and 19 of this chapter for more details.
- i. Restrict access with barriers and tape. See subparagraph 21.f of this chapter for more details.
- j. Make sure you have communications with those in the space and a method to call for emergency services. See subparagraph 21.c of this chapter for more details.

## Part 6, Safety and health practices for certain hazardous tasks

### 11. Requirements for entering a sewer

Sewer lift stations are classified as an OSHA permit-required confined space. Sewer entry differs from other permit entries in that you can rarely completely isolate the space that you will enter. The atmosphere may suddenly become deadly from causes beyond your control. To work in a sewer, you shall follow the requirements in paragraph 10 of this chapter and:

- a. Keep in contact with the local weather bureau and fire and emergency services as much as possible. This will help you know whether you should delay your entry into the sewer or cause you to remove people from the sewer if:
  1. Sewer lines might suddenly flood from rain or firefighting activities.
  2. Flammable or other hazardous materials may be released into sewers from industrial or transportation accidents.
- b. Never enter a sewer unless you are thoroughly trained in proper sewer entry procedures and the use of atmospheric testing equipment.
- c. Monitor the sewer atmosphere before entry and continuously with an instrument that sounds an audible alarm in addition to a visual display. Monitor for all of the following conditions (see subparagraphs 16.b, 16.c, and 16.d of this chapter for more details):
  1. Oxygen level within the range of 20.5% and 21.5%.
  2. Flammable gas or vapor concentrations above 0% of the LEL.
  3. Any detectable hydrogen sulfide and carbon monoxide concentrations.
- d. Carry the monitoring instrument at all times while you are in the sewer to warn you of any change in atmospheric conditions. If you are working with others in the same immediate location, the group leader may carry an instrument for the group.

### 12. Requirements for entering the JSC tunnel system

The JSC tunnel system is normally classified as a JSC permit-required confined space and is continuously ventilated. Atmospheric testing is not normally required in the JSC tunnel system because it is continuously ventilated. To work in the tunnel system, you shall follow the requirements in paragraph 9 of this chapter and:

- a. Assess the work you will be doing. If it will create new hazards that require you to upgrade to an OSHA permit-required confined space the zone that you will work in, you shall follow the requirements in paragraph 10 of this chapter.
- b. Follow your approved, up-to-date procedure.
- c. Fill out and sign a confined space permit to show that you've met safe entry conditions before you enter the tunnel.
- d. Verify through the Operations Control Center ((281) 483-2038) that the ventilation fans in the areas that you will be working in are operating.
- e. Notify the Operations Control Center ((281) 483-2038) before you enter and when you

leave the tunnel system.

- f. Wear hard hats, safety glasses, and industrial shoes (i.e., no soft-sole, open-toe, or canvas-covered shoes).
- g. Have a flashlight with you at all times.
- h. Read, sign, and follow “Tunnel Safety Awareness” at the Operations Control Center.
- i. Use the “buddy system.” Don’t enter the tunnel system alone.

### *Precautions for entering confined spaces*

#### **13. Procedure required to enter a confined space**

Before you enter any confined space, you shall have a current, approved written entry procedure that covers the specific job you will do in the space.

- a. Use JSC Form 992, “Confined Space Entry Procedure,” (Appendix 6A).
- b. The entry procedure shall:
  - 1. Be approved yearly by the Safety and Test Operations Division, the Occupational Health Department, and the contractor safety representative. You may use a procedure several times if its approval is current. If you need to change a procedure, you shall write a new one and have it approved.
  - 2. Be followed as written.
  - 3. Be posted at the entrance so that the entrants can confirm that safe entry conditions have been met.
- c. Include MSDSs for any chemicals that you will use in or near the confined space.

#### **14. Permits for entering a confined space**

Confined space entry permits document that you have met the safe entry conditions required by the entry procedure before you enter a confined space. You need to have a completed and endorsed entry permit form, JSC Form 1476, “Confined Space Entry Permit,” (Appendix 6A) to enter any confined space. Entry permits shall:

- a. Document that all safety measures required in the entry procedure are taken before entry. The entry supervisor does this by completing and signing the entry permit form to authorize personnel to enter.
- b. Be posted when completed and signed at the entrance so that entrants can confirm that safe entry conditions have been met.
- c. Be valid only for the time required to complete the job identified on the permit and only for one working shift. If you need it for a longer time, you shall get approval from the Safety and Test Operations Division and the Occupational Health Department.

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- d. Include MSDSs for any chemical being used in or near the space.

### 15. Canceling a permit

As an entry supervisor, you shall follow these requirements to cancel a permit:

- a. Cancel if one of the following occurs:
  1. The work covered by the entry permit is done.
  2. A condition arises in or near the space that is not allowed under the permit.
- b. All entrants shall leave the space when the permit is canceled.
- c. Follow these steps after you cancel the permit:
  1. Note any problems you encountered during the operation on the permit so that JSC can improve its confined space program.
  2. Send a copy of each canceled permit within one week to the Occupational Health Department for a yearly review.
  3. Keep each canceled entry permit for at least 1 year ~~to help JSC review the confined space program.~~

### 16. Controlling atmospheric hazards in a confined space

You shall control atmospheric hazards in a confined space before entering it by following these requirements:

- a. Ventilate all confined spaces with clean air for at least 30 minutes or as required by the procedure before testing the atmosphere in the confined space. If the space has permanently installed continuous ventilation that has been running and continues to run, you may enter without the 30-minute waiting period if you have met all other safe entry conditions in the procedure and permit. (In some cases, atmospheric testing may not be required in continuously ventilated spaces and as approved in the confined space procedure.) You shall follow these requirements for forced-air ventilation:
  1. Ventilate the space continuously until the job is done, whether the space is occupied or not.
  2. Don't enter the space until the forced-air ventilation has eliminated any hazardous atmosphere without approval from the Safety and Test Operations Division, Occupational Health Department, and your safety representative.
  3. Direct the ventilation to the immediate areas where employees are or will be working within the space.
  4. Take air from a clean source and make sure that the source won't increase the hazard in the space.
- b. Test the atmosphere in the confined space with a calibrated direct-reading instrument



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from outside the space as required by the procedure. ~~Testing is always required before the initial entry.~~ Periodic or continuous testing may also be required while working inside the space. A qualified person shown on the approved entry procedure needs do the initial testing. This person shall be an authorized representative of the Occupational Health Department or an employer-designated confined space entry supervisor. The Safety and Test Operations Division and the Occupational Health Department will decide who will do the testing while reviewing the entry procedure.

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Test for the following conditions **in this order** and record the results on the entry permit form:

1. Oxygen content.
  2. Flammable gases and vapors.
  3. Potential toxic air contaminants.
- c. Confirm that the following acceptable atmospheric conditions exist in the confined space before entry:
1. An oxygen level between 20.5% and 21.5%.
  2. No positive indication of a combustible, explosive, or toxic gas or vapor.

If initial testing shows conditions are unacceptable, you shall continue ventilation and retest the atmosphere unless the procedure says otherwise. If the readings continue to be unacceptable, call the Occupational Health Department at x36726 for further air quality testing.

- d. Follow these rules while working in the confined space:
1. Test the atmosphere in the space periodically to make sure that acceptable conditions are being maintained during entry operations. The time period between tests shall be specified on the confined space procedure and entry permit.
  2. Test the atmosphere continuously if you can't isolate the space because it is large or is part of a continuous system, or the work being done in the space makes continuous testing necessary.
  3. A continuously ventilated confined space may not require periodic or continuous atmospheric testing if no chemicals leak into the space or if no hazardous conditions are generated by the work being performed. If you detect a chemical leak or change in conditions in the space, you shall reevaluate the continuously ventilated space and test the atmosphere.
  4. Variations from atmospheric conditions as indicated above are acceptable.
  5. Record all readings on the permit.
- e. Make sure all instruments used to test the atmosphere in a confined space are:
1. Calibrated under the manufacturer's guidelines.
  2. Working properly before using them.

## Part 6, Safety and health practices for certain hazardous tasks

3. Labeled with calibration dates and cycles to show that they are within the calibration period.
- f. Isolate pipelines that contain flammable, toxic, irritating, or oxygen-displacing gases or vapors, if feasible, to prevent a hazardous atmosphere from forming inside the space while work is being done. Isolate pipelines by:
  1. Completely depressurizing and disconnecting possible contaminant supply lines and placing a blank flange on the pipe leading into the confined space.
  2. Using two blocking valves with a vent valve open between them.
  3. Using other blank, block, and bleed valve configurations that have been previously approved by the Safety and Test Operations Division.

### 17. Controlling other hazards in a confined space

You need to isolate energy sources to the area you in which you will be working to prevent mishaps such as electrical shock, fire, or injury from moving parts. To do this, you shall:

- a. Follow lockout/tagout and isolation requirements in Chapter 8.2, “Lockout/tagout practices,” of this handbook to:
  1. De-energize electrical or pneumatic equipment within the space.
  2. Lock and tag all control devices for fixed equipment in the space. This doesn’t include fixed lighting or ventilation equipment, unless you are working on them.
- b. Deactivate, shield, or remove all radioactive sources.
- c. Safeguard electrical equipment by:
  1. Using only properly insulated or grounded portable electrical equipment. Double-insulated electrical hand tools are acceptable. Inspect all electrical before entry.
  2. Using ground fault circuit interrupter (GFCI) circuit breakers for all case-grounded, handheld electrical equipment. GFCIs should be 4 to 6 milliamp, where possible. Place them at the power source unless the source is an ungrounded portable generator, an ungrounded battery of less than 28 volts, or an ungrounded isolation transformer of less than 28 volts.
  3. Using pneumatic power tools instead of electrical tools when possible. Pneumatic tools shall have conductive air supply hoses. Never use nitrogen or other inert gases to power the tools. Use breathable air to power pneumatic tools.
  4. Using cordless, rechargeable portable power tools, with an intrinsically safe rating, when possible. If they are used, they shall have an explosion-proof or intrinsically safe rating for spaces that could contain or develop an explosive atmosphere.
  5. Protecting temporary lighting with bulb guards or by recessing the bulbs. Power temporary lighting in locations that are wet or have standing fluids with batteries or low-voltage circuits.

6. Grounding or double-insulating heavy-duty electric cords and all metal housings.
- d. Control ignition sources by:
  1. Using explosion-proof or intrinsically safe (non-sparking) lighting, ventilation equipment, and tools in potentially flammable atmospheres.
  2. Never bringing ignition sources into an OSHA permit-required confined space until tests by a confined space monitor have confirmed that combustible or flammable gases or vapors aren't present in the space. You may work in confined space atmospheres with more than 0%, but never more than 10%, of the LEL if you have previous approval from the Safety and Test Operations Division or the Occupational Health Department.
  3. Never using polyethylene and other materials that generate static electricity where explosive atmospheres could exist. Tents erected over or around the space shall be of a conductive material and properly grounded.

*People and equipment required for  
entering confined spaces*

**18. Duties of entry supervisors**

As an **entry supervisor**, you shall, for each entry:

- a. Know the hazards entrants may face in a confined space, including information on the mode, signs or symptoms, and consequences of the hazard exposures.
- b. Make required pre-entry notifications, and coordinate all entries with your safety representative.
  1. Notify the JSC Emergency Operations Center ((281) 483-4658) and the Occupational Health Department (x36726) immediately before anyone enters an OSHA permit-required confined space.
  2. Notify the area fire warden if you will do hot work before entry. If you are at Ellington Field, notify the Ellington Field fire inspector as well (x49609).
- c. Evaluate conditions inside and outside the confined space, including temperature extremes, humidity, noise, and vibration, before entry. Determine what measures are necessary for a safe entry and to make sure that those measures are taken.
- d. Get an entry permit and check each entry to make sure of the following before signing the permit and allowing anyone to enter:
  1. All required blocks are filled in.
  2. All tests specified by the procedure have been conducted.
  3. All requirements and equipment specified by the procedure are in place.

## Part 6, Safety and health practices for certain hazardous tasks

4. The approved procedure and permit ~~is~~are posted at the job site and everyone who needs a copy has one.
- e. Make sure that all attendants and authorized entrants are properly trained before entry.
- f. Make sure that you have all other required permits, such as hot work and hazardous operations permits, before entry.
- g. Make sure that oxygen and combustible gas-monitoring devices are available, calibrated, and used for atmospheric testing if required by the entry procedure.
- h. Make sure that rescue services are available, you can maintain communications, and communication devices work.
- i. Remove unauthorized individuals who enter, or who attempt to enter, the space during operations.
- j. If you need to transfer responsibility for the space to another supervisor, make sure that operations remain consistent with terms of the entry permit and that acceptable entry conditions are maintained. Evaluate conditions as often as needed by the hazards of operations in the space.
- k. Make sure that the method of communication is appropriate for the atmosphere in the space.
- l. Remove all workers from the space and cancel the permit when the job is done or when unacceptable conditions have arisen. Provide the Occupational Health Department a copy of the canceled permit.

### 19. Duties of entry attendants

At least one attendant needs to be in the immediate vicinity outside an OSHA permit-required confined space and other spaces, if the procedure requires, while people are working in the space. As an *entry attendant* you shall:

- a. Know the hazards entrants may face in a confined space, including information on the mode, signs or symptoms, and consequences of the hazard exposures.
- b. Be aware of possible behavioral effects on entrants exposed to hazards.
- c. Continuously keep an accurate count of authorized entrants in the space on the entry permit form.
- d. Remain outside the permit space during entry operations until relieved by another attendant.
- e. Keep in visual or voice contact with authorized entrants as necessary to monitor entrant status. If the personnel in the space need to leave visual contact and verbal contact with the attendants, use mechanical or electronic communications.
- f. Monitor activities inside and outside the space to determine whether it is safe for entrants to stay in the space. Order those inside to leave the space immediately if you:

1. Detect a prohibited condition.
2. Notice behavioral effects of hazard exposure in someone in the space.
3. See a situation outside the space that could endanger those inside.
4. Can't effectively and safely perform all of your required duties.
- g. Maintain the method of contacting emergency services as required in the approved procedures.
- h. Call emergency rescue services when you see that those inside may need help to escape from hazards in the space.
- i. Take the following actions when unauthorized persons (not involved in the entry) approach or enter a permit space while entry is under way:
  1. Warn the unauthorized persons that they need to stay away from the permit space.
  2. Advise the unauthorized persons that they need to exit immediately if they have entered the permit space.
  3. Inform the authorized entrants and the entry supervisor if unauthorized persons have entered the permit space.
  4. Stop confined space operations until unauthorized personnel are removed.
- j. Perform non-entry rescues, when necessary and feasible, after notifying emergency rescue services. Never enter a confined space to rescue someone unless you are part of an emergency rescue team as described in paragraph 24 of this chapter.
- k. Never do anything that might interfere with your primary duty to monitor and protect those inside the space.

## 20. Duties of authorized entrants

If you are an *authorized entrant*, you shall:

- a. Know the hazards that you may face in a confined space, including information on the mode, signs or symptoms, and consequences of the hazard exposures.
- b. Properly use equipment as required by this chapter.
- c. Communicate with the attendant as necessary so the attendant can monitor your status and alert you if you need to evacuate the space.
- d. Alert the attendant if you:
  1. Recognize any warning sign or symptom of a dangerous situation.
  2. Detect a prohibited condition.
- e. Exit from the permit space as quickly as possible if you:
  1. Get an order to evacuate from the attendant or the entry supervisor.

## Part 6, Safety and health practices for certain hazardous tasks

2. Recognize any warning sign or symptom of a dangerous situation.
3. Detect a prohibited condition.
4. Hear an evacuation alarm.

### 21. Equipment for entering a confined space

You shall have the following equipment before you enter as required by the procedure:

- a. Portable ventilating equipment for spaces without permanent mechanical ventilation. You are responsible for providing ventilating equipment.
- b. Testing and monitoring equipment for atmospheric testing as indicated on approved entry procedures. You are responsible for providing testing equipment.
- c. Communications equipment that is compatible with the atmosphere in the space for communicating with entrants and emergency services.
- d. GFCI for all portable electrical equipment.
- e. Lighting equipment for safety while working in and exiting the space.
- f. Barriers and shields to prevent inadvertent entries into confined spaces while work is in progress. Post the following sign at all open entrances to confined spaces:

**CAUTION CONFINED SPACE WORK IN PROGRESS.**

**NO ENTRY WITHOUT PERMIT AND PROCEDURE.**

- h. Equipment, such as ladders, needed to safely enter and exit the space.
- i. Any other equipment necessary for safe operations in the space.

### 22. Protective clothing and equipment for entering a confined space

If you enter a confined space, you shall wear PPE as required in the procedure to protect you from hazards in the space:

- a. Hard hats to protect you from falling objects or overhead bump hazards.
- b. Impervious personal protective clothing if you will work with corrosive or irritating products or toxic chemicals that penetrate the skin.
- c. Eye or face protection if your eyes or face could be hurt.
- d. Industrial shoes (no soft-sole, open-toe, or canvas-covered shoes).
- e. Respiratory protection for hazardous atmospheres. You shall also follow these requirements:
  1. If you wear a respirator in a confined space, you shall follow Chapter 7.2, "Respiratory protection," of this handbook.
  2. Use only NIOSH-approved respirators.

3. Use a self-contained breathing apparatus (SCBA) only when you can fit through the entry openings with an SCBA strapped on. If you can't do this, or if free space opening is less than or equal to 18 inches in diameter, use a supplied-air respirator.
4. Use only certified breathing air (Compressed Gas Association, Grade D).
5. See Chapter 5.6, "Personal protective equipment," of this handbook for more requirements on PPE.

### 23. Rescue and emergency equipment

You shall have non-entry rescue and emergency equipment in place before anyone enters the confined space as required in the approved procedures. Never enter a confined space to rescue someone. You shall have:

- a. Retrieval equipment for anyone who enters an OSHA permit-required confined space, unless that equipment would increase the overall risk of entry or would not help you rescue an entrant. Each entrant shall have the following retrieval equipment:
  1. A chest or full-body harness with a retrieval line that meets ANSI A10.14, "Construction and Demolition Operations – Requirements for Safety Belts, Harnesses." You shall attach the retrieval line at the center of the entrant's back, near shoulder level, or above the entrant's head. Inspect harness and lines before each use and load test them yearly as described in the manufacturer's instructions.
  2. Wristlet harnesses instead of a chest or full-body harness if access to the confined space is less than 18 inches in unobstructed diameter. You may also use wristlet harnesses if you can show that a chest or full-body harness isn't feasible or creates a greater hazard. You need to show that wristlet harnesses are the safest and most effective alternative. The Safety and Test Operations Division and the Clinical Services Branch shall approve any exceptions.

**Note:** Wristlets are designed to help remove people from confined spaces by extending their arms, but are not designed to lift a person out of a space. Use a full-body harness instead.
  3. A retrieval line from the harness that is attached to a mechanical device or fixed point outside the space so that you can begin rescue if you are aware that rescue is necessary.
- b. A mechanical hoist and supporting structure over the opening for OSHA permit-required confined spaces with top-opening entrances or that are vertical and more than 5 feet deep. The entry supervisor may require hoist and support for JSC permit-required confined spaces with top-opening entrances.
- c. Extra supplied air respirators for rescuers if the entrants use supplied air respirators to work in the space. You usually use supplied air respirators if openings aren't large enough for SCBAs or the job will last longer than an SCBA's air supply. Inspect and check all rescue respirators before anyone enters the space.

## Part 6, Safety and health practices for certain hazardous tasks

- d. Any other equipment necessary to safely rescue someone from the space.
- e. A method of contacting emergency services as required in the approved procedures.

### 24. What to do in an emergency

Remember, your emergency numbers are: x33333 at JSC and Sonny Carter Training Facility, x44444 at Ellington Field, 911 at any off-site location, and x5911 at WSTF.

In an emergency, you as an *attendant* or *entry supervisor* shall:

- a. Follow your emergency procedures. Never attempt to rescue a worker from a confined space until you call your emergency number or call for a rescue team.
- b. Never enter a confined space to rescue someone. Only approved rescue teams that meet the requirements of 29 CFR 1910.146(k) and are approved by the Safety and Test Operations Division and the Occupational Health Department may enter a confined space for rescue.
- c. Make sure an MSDS or similar written information is provided to the medical facility treating an entrant who is exposed to a hazardous substance if you have the MSDS or information at your worksite.
- d. Coordinate with local fire and ambulance services if you rely on them for confined space rescues by:
  - 1. Telling them about the hazards that they may face during confined space rescues.
  - 2. Having them visit all confined spaces to which they may be called so that they can develop rescue plans for each space and practice rescue operations.

### *Other requirements for entering confined spaces*

### 25. Training for working in confined spaces

Training needs to provide supervisors, attendants, and entrants with the knowledge and skills needed to work safely in confined spaces. Training shall follow these requirements:

- a. If you are involved with any work in a confined space, you shall have training:
  - 1. Before you are first assigned duties in confined spaces and before your assigned duties change.
  - 2. Whenever work in a confined space presents new hazards you have no training for.
  - 3. Whenever you think that there are deviations from entry procedures or that your knowledge or use of the procedures may be inadequate.
  - 4. By taking JSC's Confined Space Entry course. This course meets the requirements of



29 CFR 1910.146 for entry supervisors, attendants, and entrants. You may also take current off-site training after you attend an overview of JSC's confined space program and demonstrate that you understand JSC's program.

5. By getting a training completion card that states that you have been trained and demonstrated proficiency in JSC's confined space requirements. The card is good for 2 years. Then you shall be retrained.
- b. As an **entry supervisor**, you shall at least have training in JSC's confined space entry program and in your duties listed in paragraph 18 of this chapter.
- c. As an **entry attendant**, you shall at least have training in JSC's confined space entry program and in your duties listed in paragraph 19 of this chapter.
- d. As an **authorized entrant**, you shall at least have training in JSC's confined space entry program and in your duties listed in paragraph 20 of this chapter.

## 26. Off-site contracts that involve entering confined spaces

For off-site contractors involved in entering confined spaces:

- a. If you arrange to have employees of an off-site contractor perform work in a confined space, you shall:
  1. Inform the contractor that the workplace has confined spaces and that the contractor needs to follow JSC's confined space entry program when working in confined spaces.
  2. Tell the contractor why a space in question is a confined space, including the hazards identified and JSC's experience with the space.
  3. Tell the contractor of any precautions or procedures that JSC has implemented under its program to protect employees in or near the spaces that contractor personnel will be working in.
  4. Make sure that contractor employees who will enter confined spaces receive the training in paragraph 25 of this chapter.
  5. Coordinate entry operations with the contractor.
  6. Debrief the contractor when the job is done about JSC's permit space program and the hazards found or created in the spaces during entry operations.
- b. If you are the contractor in subparagraph a above, you shall follow JSC's confined space requirements in this chapter and:
  1. Obtain any available information on permit space hazards and entry operations from the contracting organization.
  2. Make sure that all employees who will work in confined spaces are trained as described in paragraph 25 of this chapter. They shall also provide documentation of prior class work in confined space entry, receive the JSC confined space overview,

## Part 6, Safety and health practices for certain hazardous tasks

- and demonstrate an understanding of JSC's program.
3. Coordinate entry operations with the contracting organization.
  4. Inform the contracting organization of any hazards that you find or create in any confined space, either at a debriefing or while you are working.

### 27. For more information on entering confined spaces

You can find more information on entering confined spaces in these documents:

- a. 29 CFR 1910.146, "Permit-Required Confined Spaces"
- b. ANSI A10.14-91, "Safety Belt Use"
- c. ANSI Z1171.1-1989, "Standard on Confined Space Entry"
- d. NIOSH Criteria Document on Working in Confined Spaces
- e. NIOSH Publication IF 87-113, "A Guide to Safety in Confined Spaces"
- f. NHS/IH 1845.2, Publication No. 80-106, "Entry Into and Work in Confined Spaces"

## Requirements for controlled areas

### 28. Definition of a controlled area

A controlled area is one that

- a. An employee can completely enter and work in the area, but is not, by definition, a confined space.
- b. Periodically contains, or can, after a single point failure, contain a hazardous atmosphere where employees are present that may expose them to the risk of death, or acute illness, injury, incapacitation, and impairment of ability to self rescue from any of the following conditions:
  1. Flammable gas, vapor, or mist in excess of 10% of its lower explosive limit (LEL).
  2. Airborne combustible dust at a concentration that meets or exceeds its LEL.
  3. Atmospheric oxygen concentrations below 19.5% or above 23.5%. Note: Atmospheric oxygen concentrations may vary significantly due to stratification or inadequate mixing; e.g., be acceptable at one location but not another.
  4. Atmospheric concentration of any substance for which there is a published exposure limit and which could result in employee exposure in excess of that limit.
- c. Contains any other condition that is immediately dangerous to life or health.

Examples of controlled areas include:

- Vacuum chambers (during non-test conditions).

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- Hyperbaric and hypobaric chambers.
- WSTF Altitude Test Stands.
- Enclosed outdoor areas for loading liquid nitrogen.
- Laboratories with compressed or plumbed gas lines or LN2 dewars.
- Temporary work areas where construction, welding or other work processes can create the conditions described above.

### **29. Identifying a controlled area at JSC**

To identify controlled areas, you shall:

- Evaluate your work areas to identify any controlled areas. Consult safety or health representatives to help in the determination. Consider the area based on its use when personnel are present. For example, evaluate the interior of a vacuum test chamber during periods for maintenance, test article mounting, instrumentation set-ups, etc. Do not evaluate a vacuum chamber while it is at vacuum under test conditions.
- Designate an area as “controlled” if occupational safety or health representatives determine it should be a controlled area after close calls, mishap, hazard analysis, or other inspection indicate hazards require additional mitigation or monitoring.

NOTE: Depending on the configuration of the area, a controlled area may be upgraded to a JSC or OSHA permitted confined space.

### **30. What to do if you have controlled areas in your work area**

If you, as a facility manager or line manager, have a controlled area in your work area, you shall:

- Ensure the controlled area is covered by a Hazard Analysis per chapter 2.4 of this document. The Hazard Analysis shall also include:
  - Control of both hardware configuration and procedures that may generate the hazardous condition. Consider an entry checklist, procedure, warning signs, or training.
  - Any critical timing associated with the controls. Note that there are trades to be made. If the valve were closed and locked the critical time may be extended to a shift or longer.
- Notify the Clinical Services Branch of the controlled area.
- Include the hazard analysis in the facility baseline documentation if required by chapter 10.4.
- Periodically assess the effectiveness of controls by field inspection.

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### **31. Responsibilities**

## Part 6, Safety and health practices for certain hazardous tasks

The following organizations have responsibilities for controlled areas:

a. The Clinical Services Branch shall:

1. Maintain a list of controlled areas under these requirements.
2. Assess the effectiveness of controlled area controls yearly.

b. The Safety and Test Operations Division shall:

1. Assess the hazard analyses and controls during audits of the facility.
2. Assess workplace conditions for compliance with these requirements during periodic facility inspections.

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# Chapter 6.11

## Pressurized Gas and Liquid Systems

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### ***This could be you . . .***

*A technician was burned by a fire in a component of a high-pressure oxygen system.*

*An expansion bellows on a section of piping ruptured during pressure testing and injured several employees. The bellows wasn't properly restrained during the testing.*

*A gate valve on a high-pressure nitrogen trailer flew off and killed an employee during maintenance. The maintenance workers didn't take all possible steps to make sure that the trailer wasn't pressurized before working on it.*

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### **1. Applicability of this chapter**

You are required to follow this chapter if you use pressurized gas or liquid systems.

### **2. Requirements for using any pressurized systems**

All your pressure vessels, pressure systems, and pressure systems components shall:

- a. Be designed, installed, tested, certified, and periodically recertified to the requirements of JPR 1710.13, "Design, Inspection, and Certification of Pressure Vessels and Pressurized Systems" (current version).
- b. Have their current design, installation, testing, certifications, modifications, periodic recertifications, and maintenance properly documented.
- c. Be marked, tagged, or otherwise identified to indicate the certified use.
- d. Be located to minimize the risk to personnel and surrounding equipment and facilities if a leak or rupture occurs.

### **3. Requirements for systems that contain pressure vessels, fixed piping or tubing, valves, or other components**

Your pressure systems shall:

- a. Meet JPR 1710.13 (current version) for the design, installation, testing, certification, and periodic recertification of your pressure vessel.
- b. Meet American Institute of Aeronautics and Astronautics (AIAA) Guide 095-2004, "Guide to Safety of Hydrogen and Hydrogen Systems," specifications if your pressure system contains hydrogen.
- c. Make sure that relief valves and other discharge parts follow minimum separation distances as called out in the references given above.

## Part 6, Safety and health practices for certain hazardous tasks

- d. Properly restrain relief valves, rupture discs, burst discs, and associated piping or tubing to prevent movement from the thrust created by a pressure release.
- e. Properly bond and ground your systems.

### 4. Requirements for fire protection systems

All fire protection systems shall meet the requirements of the NFPA for the specific type of fire protection system involved.

### 5. Requirements for flex hoses

You shall meet the following requirements:

- a. Proof pressure-test and tag flex hoses according to the requirements of JPR 1710.13 (current version).
- b. Secure flex hoses that are not in a cabinet or other containment and that are used in 150-psig or greater normal service at both ends and tether or weigh them down at no greater than 6-foot intervals, and you shall:
  - 1. Secure hoses between 3 and 6 feet in length at both ends and tether or weigh them down in the middle. Hoses shorter than 3 feet in length only need to be secured at both ends.
  - 2. Ensure that this securing, tethering, or weighting is sufficient to withstand forces arising from sudden failure. Strapping hoses together is considered tethering.
  - 3. Secure flex hose vent and drain lines at the free end.

c. Flex hoses need not be secured if in vacuum service or a written hazard analysis or technical order, which controls the hazard, is approved Safety and Test Operations Division.

~~e.d.~~ For commercial off the shelf (COTS) flex hoses, with the exception of hoses having quick disconnect type fittings, the hose end fittings connected to rigid pieces are considered to provide adequately secured restraint at the hose ends without having to redundantly secure them by any additional method such as tethering or strapping. A rigid attach point is defined as fixed hardware capable of withstanding MAWP. Hoses longer than 3 feet with ends secured in this manner must still be secured in the middle and at intervals not to exceed 6 feet.

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### 6. Requirements for systems using oxygen or oxygen-enriched gas (greater than 25 mole percent oxygen or oxygen greater than 25% oxygen by volume)

You shall meet the following requirements:

- a. Oxygen systems shall meet NASA-STD-6001, "Flammability, Odor, Off-Gassing and Compatibility Requirements and Test Procedures for Materials in Environments that Support Combustion." Use ASTM MNL36, "Manual for Safe Use of Oxygen Systems:

## Chapter 6.11, Pressurized Gas and Liquid Systems

Guidelines for Oxygen System Design, Materials Selection, Operations, Storage, and Transportation,” as a guide.

- b. For systems using oxygen or oxygen-enriched gas above 250 psi and that involve humans in the loop, you need to flow the oxygen through the system unmanned before introducing a human into the system. Examples of these systems include chambers and breathing gas systems. Testing shall follow these requirements:
  1. Test new systems and test, after modifications, existing systems that require disassembly and reassembly of the parts of the system.
  2. Test the system at maximum operating pressure (just below relief valve pressure) for 10 cycles.
  3. Sample for chemical purity per MIL-PRF-27210G. Also test moisture levels per specific program requirements. Sample the system before use, or monthly and after any maintenance activities that violate system integrity.

### 7. Requirements for using non-bulk compressed gas cylinders

You shall meet all the requirements of 29 CFR 1910.101, “Compressed Gas Cylinders,” and any additional requirements defined by Center Operation Directorate or by contract.

Firm fixed price contractors that are supporting Construction of Facilities (CoF) projects at JSC, Ellington Field and SCTF are allowed to bring all necessary gases needed for the on site provided they meet all NASA, OSHA, site and contractual requirements to ensure handling, transport and use of required gases. For all other contractors or JSC organizations, The Logistics Division is the only authorized avenue for purchasing and disposing of non-bulk compressed gas cylinders for use at JSC, Ellington Field, and SCTF, ~~including gases used by onsite contractors.~~ For safety and accountability, NASA and vendor owned are tracked, disposed of, and/or returned to vendors when no longer required. Any unauthorized gas purchases will be held in the hazardous storage area and may be returned to the vendor. As an authorized user of compressed gas cylinders, you shall:

- a. Send gas requests to the Logistics Support Contractor/Bldg. 421 on a JSC Form (JF) 1710, JSC Warehouse Requisition, or fax to 46540.
- b. Contact the Logistics Support Contractor at extension 36547 for pickup of cylinders that are empty or no longer needed.
- c. ~~For~~ Ensure that a completed JSC Form 1161 accompanies any cylinder(s) that contain hazardous material(s), ~~list the contents on JSC Form 1161 and attach the completed form to the cylinder(s) before pickup to ensure correct disposition. If the cylinder is empty, no form 1161 is required. (A compressed gas container is empty if it is at atmospheric pressure.)~~

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## Part 6, Safety and health practices for certain hazardous tasks

~~8-~~ NOTE: "Exceptions to purchasing gases through the Logistics Division may also be granted for specialty gases used in experiments with the concurrence of the Logistics Division, the Safety and Test Operations Division, and the Clinical Services Branch."

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### 8. For more information on pressurized gases and liquids

You can find more information on pressure systems in the following:

- a. 29 CFR 1910.101
- b. JPR 1710.13 (current version)
- c. NASA-STD-6001, "Flammability, Odor, Off-Gassing and Compatibility Requirements and Test Procedures for Materials in Environments that Support Combustion"
- d. ASTM MNL36, "Manual for Safe Use of Oxygen Systems: Guidelines for Oxygen System Design, Materials Selection, Operations, Storage, and Transportation"
- e. AIAA Guide 095-2004, "Guide to Safety of Hydrogen and Hydrogen Systems"



## Chapter 8.2

### Lockout/tagout practices

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#### ***This could be you . . .***

*An electrician received a shock from a 480-volt alternating current source while modifying a motor controls panel. The hot junction was an undocumented change to the panel. The electrician could have been electrocuted but only suffered injury since the current passed through the arm only.*

*An operator failed to turn off and lockout a pipe-cutting machine after it stalled. He lost a finger as a result because he touched the chain and sprocket drive when the machine unexpectedly restarted.*

*Employees who were not certified to service or operate a crane violated a Do Not Operate tag and operated the crane. They damaged highly valued equipment.*

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#### **1. Applicability of this chapter**

You are required to follow this chapter if you work at JSC, including Ellington Field or Sonny Carter Training Facility, whether a civil service or contractor employee. If you work at a JSC field site, follow local requirements that meet the intent of this chapter. Specific categories of employees under this chapter are:

- a. **Authorized employee:** A person who locks out or tags out machines or equipment to service or maintain those machines or that equipment.
- b. **Affected employee:** An employee whose job requires him or her to operate or use a machine or equipment that is being serviced or maintained under lockout/ tagout, or whose job requires him or her to work in an area in which the servicing is being done. An affected employee becomes an authorized employee when the employee's duties include servicing or maintenance covered under LO/TO.
- c. **Other employee:** An employee whose work operations actually is, or potentially may be, in an area during the period when energy control procedures will be used.
- d. **Task Group Representative (TGR):** A person who is responsible for the identification and locking/tagging of the energy isolation points during group LO/TO. This individual maintains control of the group lock box during the entire duration of the maintenance or service task. A TGR is required for any group LO/TO.

#### **2. JSC's LO/TO program**

This chapter is JSC's LO/TO standard, which designed to implement compliance at JSC with 29 CFR 1910.147, "The Control of Hazardous Energy (Lockout/Tagout)." It provides a consistent and uniform policy and *minimum* requirements for locking out and tagging out

## Part 8, Safety and health practices for manufacturing, repair, and maintenance

energy-isolating devices during maintenance, service, or repairs on machinery, equipment, or systems. The intent of this chapter is to ensure that machines, equipment, and/or systems are properly and uniformly locked out and tagged out throughout JSC, and that **ALL** employees are protected from exposure to an unexpected energy release. The following requirements apply:

- a. Each project, contractor, or organization may take this basic LO/TO standard and add addendums to meet their particular operations and procedures, as long as the intent of the standard is met or exceeded, followed by all employees, and strictly enforced.
- b. Projects, contractors, and organizations shall develop, document, and use procedures for controlling potentially hazardous energy unless specifically exempted under 29 CFR 1910.147(c)(4)(i). These procedures are required to meet the requirements in this chapter and clearly and specifically outline the scope, purpose, authorization, rules, and techniques that you will use for controlling hazardous energy, and the means to enforce compliance including, but not limited to, the following:
  1. A specific statement of the intended use of the procedure.
  2. Specific procedural steps for shutting down, isolating, blocking, and securing machines or equipment to control hazardous energy.
  3. Specific procedural steps for placing, removing, and transferring LO/TO devices or tagout devices and the responsibility for them.
  4. Specific requirements for testing a machine or equipment to verify the effectiveness of lockout devices, tagout devices, and other energy control measures.

### 3. Other special conditions

This chapter does not apply to the following:

- a. Work on cord- and plug-connected electrical equipment where the hazard of unexpected energizing or start up of the equipment is controlled by meeting both of the following conditions:
  1. ~~the~~ Unplugging of the equipment from the energy source.
  2. ~~and by~~ Keeping the plug ~~being~~ under the exclusive control of the employee performing the servicing or maintenance. At no time should servicing or maintenance be performed while the equipment is plugged in. You may troubleshoot electronic circuits if you have an approved safe procedure and follow the requirements in chapter 8.1, "Electrical Safety.
- b. Hot tap operations involving transmission and distribution systems for substances such as gas, steam, water, or petroleum products on pressurized pipelines, provided that the project, contractor, or organization demonstrates that all of the following are true:
  1. Continuity of service is essential.
  2. Shutdown of the system is impractical.
  3. Documented procedures were followed and special equipment was used to provide

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## Chapter 8.2, Lockout/tagout practices

proven effective protection for employees.

### 4. Contractors

There are exceptions to LO/TO requirements for work done at JSC facilities. The following requirements apply:

- a. If you contract or sub-contact for services, you are responsible for notifying contractors or subcontractors of this requirement, and shall provide a copy of this chapter to the contractor or subcontractor.
- b. All contractors shall make sure that their employees understand and follow this JSC LO/TO standard.

### *Requirements and procedures for Lockout/Tagout*

### 5. General requirements and enforcement

The following requirements apply to all employees, machines, and equipment at JSC:

- a. If you see a piece of equipment that is locked out or tagged out, you **shall never** attempt to start, energize, or use that machine or equipment except as required to verify isolation in subparagraph 6.g. below.
- b. If you are an “authorized employee,” you shall follow the procedures listed below when locking out or tagging out a component or system.
- c. If you violate LO/TO, you are subject to disciplinary measures by your employer as described in Chapter 3.7, “Disciplinary System,” of this handbook.
- d. When installing new machines or equipment, or when replacing, doing major repairs on, renovating, or modifying existing machines or equipment, you shall design the energy-isolating devices to accept a lockout device.

### 6. JSC’s basic LO/TO requirements

You shall follow these steps when maintaining, servicing, or repairing equipment:

- a. Prepare for shutdown. Determine the type and magnitude of the energy, the hazards of the energy to be controlled, and the method or means by which to control the energy.
- b. Notify “affected employees” who operate the equipment that you will be working on.
- c. Shut down equipment using procedures established for that machine or equipment.
- d. Isolate all energy sources.
- e. Attach LO/TO isolation devices as described in paragraphs 7 and 8 below. Also note the requirements for group lockout and shift changes in paragraphs 12 and 13 below.
- f. Release all potential or stored energy, as described in paragraph 9 below.
- g. Verify the isolation, including testing; see paragraph 10.

## Part 8, Safety and health practices for manufacturing, repair, and maintenance

- h. Service, repair, or maintain the equipment.
- i. Inspect the work to ensure that all nonessential items have been removed and that machine or equipment components are operationally intact. Make sure that all employees have been safely positioned and are not in the operational area before re-energizing the equipment.
- j. Notify “affected employees” that lockout or tagout devices will be removed.
- k. Remove LO/TO isolation devices as described in paragraph 11 below.
- l. Restore the equipment to operation.

**Note:** If the equipment you will be working on has another lock or tag, such as the “WARNING” DO NOT OPERATE tag, or another employee’s lock and tag, you still need to lockout and tagout the equipment per this chapter before you work on it.

### 7. Hardware (locks and lockout devices)

Attaching locks, tags, and other necessary hardware will ensure that the energy isolation device cannot be inadvertently switched or changed during maintenance or repair activities. To get locks for lockout, follow the “Policy on issuing locks and tags” in Attachment 8.2B, Appendix 8B. The following requirements apply to locks and lockout devices:

- a. **Locks. You shall only use locks provided by JSC for isolating, securing, or locking equipment from all potential energy sources.** Dedicated lockout padlocks at JSC are “RED” in color and individually keyed and numbered. Never use a RED lock for any other purpose.
- b. **Other lockout devices.** These include, but are not limited to, chains, wedges, key blocks, adapter pins, self-locking fasteners, or other hardware for isolating, securing, or blocking of machines or equipment from energy sources. Your company or organization will provide these devices. They shall be substantial enough to prevent removal without the use of excessive force or unusual techniques, such as with the use of bolt cutters or other metal-cutting tools.

### 8. LO/TO tags

**If you are going to personally work on a system, you shall only use the red LO/TO form (JSC Form JF 1291) and attach them by putting the lockout through the grommet or by using a nylon cable ties provided by JSC.** To get tagout tags, follow the “Policy on issuing locks and tags” in Attachment 8.2B, Appendix 8B. The following requirements apply to tags:

- a. Tags are essentially **informational devices** attached to the lockout devices. Tags do not provide the physical restraint provided by a lock. If you use a tag without a lockout device, you shall also use other methods to isolate all sources of energy such as block and bleed, blinds, valve hand-wheel removal, etc.
- b. These other methods shall be at least as effective as a lockout device would have been, if

## Chapter 8.2, Lockout/tagout practices

it were used.

- c. If an energy-isolating device is not capable of being locked out, you shall use a tagout device instead.
- d. You shall also use all reasonable means to make sure that the energy-isolating device is not operated.
- e. When a tag is attached for energy isolation, no one may remove it without the authorization of the person responsible for the tag. It shall never be bypassed, ignored, or otherwise defeated. Never energize the system when a tag is in place except under specific conditions per written procedure outlined in this chapter (testing system to ensure that there is no power, etc.).
- f. You shall attach tags either to the padlock or to the same point as the padlock.
- g. For energy-isolating devices that are not capable of being locked out, you shall attach the tag to the device or as close as safely possible to the device and in a position that will be immediately obvious to anyone attempting to operate the device.
- h. Tag information shall be legible and understandable.
- i. You shall never use the red LOCKOUT TAGOUT tag as a WARNING, DO NOT OPERATE tag. The Danger, LOCKOUT TAGOUT (JF 1291) tag means one thing and one thing only: that you are personally working on the system.
- j. JSC tags contain log and tag number spaces, which you may use as best fits to your needs, but you shall address the log and tag numbers in any LO/TO procedures you develop.

## 9. Releasing stored energy

After attaching lockout or tagout devices to energy isolating devices, you shall relieve, disconnect, restrain, and render safe all potentially hazardous stored or residual energy. Stored or residual energy could include, but is not limited to electrical capacitors, batteries, contained hydraulic or pneumatic pressure, springs, and suspended weights. If the stored energy could re-accumulate to a hazardous level, continue to verify isolation until the servicing or maintenance is completed, or until the possibility of the energy accumulation no longer exists.

## 10. Verifying isolation

Before starting work on the machinery, equipment, or system that has been locked out or tagged out, you, as an authorized employee, shall verify that the equipment has been isolated and de-energized by the following:

- a. Verify that personnel are not exposed to potential danger.
- b. A qualified person shall “test” the isolation of the equipment by ***attempting to energize it, using the normal operating controls*** (where possible) to make certain that the machinery, equipment, or system will not operate.
- c. A qualified person using the appropriate equipment shall verify that previously energized parts that are exposed are free of energy before removing electrical PPE or exposing any unprotected persons. If the circuit to be tested is over 600 volts, test the test equipment

## Part 8, Safety and health practices for manufacturing, repair, and maintenance

tested for proper operation immediately after the test.

- d. If pressure sources are involved, verify on a gauge, open a vent valve, or use other positive verification methods.

**Caution:** *Return operating controls to neutral or off position after attempting to start.*

### 11. LO/TO lock release or removal

Only one key is authorized for each red LO/TO lock and LO/TO tag and *only* the person who attached the lock is authorized to remove the lock and maintain custody of the key. The TGR is the only person who is authorized to release and remove the LO/TO lock and tag from his or her assigned group lock box. There is a ***special condition to this rule***: If the employee who attached the red LO/TO lock and LO/TO tag is not at the facility and is unavailable to remove the lock, the supervisor is authorized to remove the lock after following the procedure below. If you need a red LO/TO lock removed, you shall contact the employee's supervisor. If you, as a supervisor, are asked to remove a red LO/TO lock with a LO/TO tag, you shall follow these steps:

- a. Confirm that the employee who attached the lock is not at the facility and not available to remove the lock.
- b. Attempt to contact the employee. Call home phone, cell phone, or pager. Document all attempts to contact the employee.
- c. Make sure all work is completed and that no employees are exposed to any type of hazards created by removing the LO/TO device(s).
- d. Notify all affected employees that you will be removing the lock.
- e. Have a qualified employee test and visually inspect the equipment, as necessary, to verify that all tools, electrical jumpers, shorts, grounds, and other such devices have been removed so that the circuits and equipment can be safely energized.
- f. Remove the lock. Avoid destroying the lock if possible by cutting the chain, hasp, or other restraining device.
- g. Immediately inform the authorized employee whose lock you removed that the lock has been removed when he or she returns to the facility or becomes available, ***and before*** he or she returns to the task or system where the lockout was in effect. You may need to notify coworkers, leave a phone voice message, an email, or use other means to notify him or her to report to you ***before*** going to the task or system where the lockout was in effect. Your message shall say that their lock has been removed and the system is now live or dangerous if work is resumed.
- h. Return an undamaged lock to the employee with an explanation of circumstances as soon as possible.

## 12. Group lockout

An LO/TO application may involve more than one maintenance, repair, or servicing employee or more than one point of energy isolation. Several options exist for “group” LO/TO procedures. The examples in subparagraphs c–f below for group LO/TO illustrate the range of approaches. These examples are not intended to represent the only acceptable procedures for group LO/TO. The primary requirement is that the process used shall provide the employee protection equivalent to using a personal LO/TO. This would include use of “controlled key locks” and appropriate tags per a written procedure for the task. The following requirements apply:

- a. An important element of “group LO/TO” is to enable the TGR to initially lockout and tagout the system and place all LO/TO keys and tag tabs in a group lockbox. Then the TGR hangs an LO/TO tag with a red LO/TO lock on the lock box. The TGR controls the key while he or she is working the task. Each authorized person shall install his or her individual red LO/TO lock and LO/TO tag on the lockbox.
- b. The energy isolation devices shall never be released until all authorized personnel and the TGR have removed all locks and tags from the lockbox. The TGR is responsible for control of the lock box and key. The control responsibility of the TGR may be transferred between shift changes and job reassignments.
- c. Single energy source, multiple maintenance, servicing personnel, and *single point with use of multi-lock adapter (figure 8.2-1)*:
  1. If the equipment operation is the responsibility of a system operator or user, that individual may configure the equipment without any tag or lock.
  2. Each authorized person who will be performing the maintenance or service task shall install individual red LO/TO lock and LO/TO tag at the de-energized single-energy control point before starting work. This will often require the use of a multi-lock adapter to accommodate the numerous locks.
  3. If energy isolation is required during periods where the work area may be unattended by authorized personnel, a TGR installs a separate red LO/TO tag and red LO/TO lock at the single-energy control point at the time of isolation. The TGR shall maintain control of the key throughout the maintenance or service task period.
- d. Single energy source, multiple maintenance, servicing personnel, and *single point with use of lockbox*:
  1. An alternate procedure is to use a lockbox when the number of locks and tags are too numerous to be supported by the single energy control point.
  2. If the equipment operation is the responsibility of a system operator or user, that individual may configure the equipment without any tag or lock.
  3. The TGR shall attach a red LO/TO tag marked or stamped with the words “for group LO/TO” and a red LO/TO lock at the de-energized single energy control point at the time of isolation. The key is then placed in the lockbox.

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4. The TGR shall install a red LO/TO tag and a red LO/TO lock on the lockbox.
5. The TGR shall maintain control of the key throughout the maintenance or service task period until all work is completed and the equipment is safe to reactivate. This provides energy isolation during periods where the work area may be unattended by authorized personnel.
6. The authorized personnel who will be performing the maintenance or service task shall each install individual red LO/TO lock and LO/TO tag on the lockbox before working.

### Example Of Group Lockout for Single Energy Source

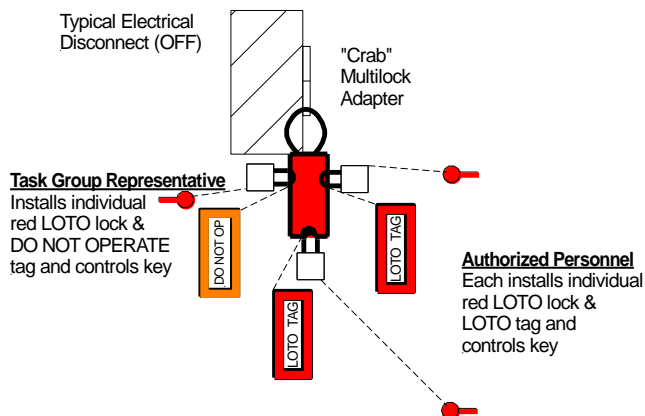


Figure 8.2-1. Group lockout tagout concept for single energy control point.

- e. Multiple energy sources, multiple maintenance, servicing personnel, and **multiple point sources using lockbox (figure 8.2-2)**:
  1. An alternate procedure is to use a lockbox when there are multiple energy control points. This alternate procedure applies regardless of requirements by other parties such as control of the equipment operation by a system operator or user and the use of other tags and locks (such as a Do Not Operate tags with appropriate shop or craft locks).
  2. The TGR shall attach a red LO/TO tag marked or stamped with the words "for group LO/TO" and a red LO/TO lock at each energy control point at the time of isolation. The keys are then placed in the lockbox.
  3. The TGR shall install a red LO/TO tag marked or stamped with the words "for group



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LO/TO” and a red LO/TO lock on the lockbox.

4. The TGR shall maintain control of the key throughout the maintenance or service task period until all work is completed and the equipment is safe to reactivate. This provides energy isolation during periods where the work area may be unattended by authorized personnel.
5. The authorized personnel who will be performing the maintenance or service task shall each install individual red LO/TO lock and LO/TO tag on the lockbox before working. This option requires the least number of locks and ensures that each person has control of the total system when he or she is working on the system.

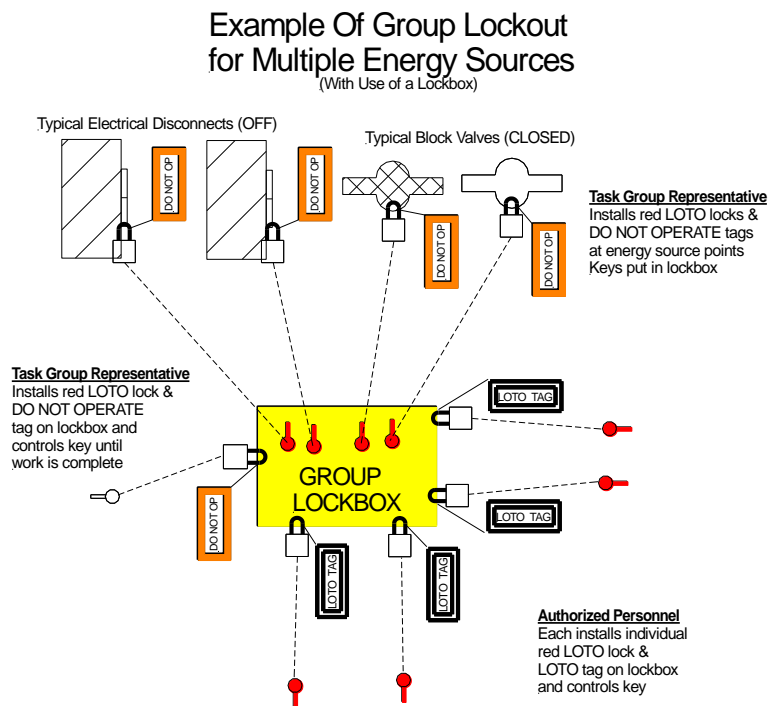


Figure 8.2-2. Group LO/TO multiple energy source control points.

- f. Multiple energy sources, multiple maintenance, servicing personnel, and **multiple point sources using multi-lock adapters**:
  1. If the equipment operation is the responsibility of a system operator or user, the user or operator may have to use other tags (such as the “Do Not Operate tag”) with appropriate shop or craft locks.

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2. Each authorized person who will be performing the maintenance or service task shall install individual red LO/TO lock and LO/TO tag at each of the multiple energy control points before starting work. To accommodate multiple objectives, this will often require the use of a multi-lock adapter to accommodate the numerous locks.
3. The TGR shall attach a red LO/TO tag marked or stamped with the words “for group LO/TO” and a red LO/TO lock at each energy control point at the time of isolation. This provides ongoing, uninterrupted lockout during periods where the work area may be unattended by authorized personnel.
4. The TGR shall maintain control of the keys throughout the maintenance or service task period.

### 13. LO/TO during shift changes

During the course of work, work crews may take turns working on the locked out equipment. The following requirements apply:

- a. If a new authorized person or crew of authorized persons carries on the work started by an earlier crew, arriving employees shall attach their own locks and verify energy isolation, and departing employees shall remove their locks.
- b. Each authorized person shall use his or her own red LO/TO locks. When multiple shifts work on a locked out system, the TGR will be responsible for making sure that all authorized personnel have either installed individual red LO/TO locks and tags at all energy sources or the appropriate group lockbox.
- c. Arriving employees shall verify energy isolation.
- d. When a system must be handed over to a new crew to continue the work and there is equipment already locked and tagged out, this constitutes a shift change and you shall follow these steps:
  1. Inform the arriving shift or crew of the devices, hazards, and other employees that are involved in this particular lockout/ tagout operation.
  2. The employees on arriving shift or crew attach their lockout and tagout devices on the isolation device(s) that are currently locked and tagged.
  3. The employees on the departing shift remove their lockout and tagout devices.
  4. The TGR for the departing group will be the last person of the departing group to remove his or her lock; this ensures energy isolation at all times until the new TGR is ready to accept the responsibility. Similarly, the arriving TGR will be the first person of the arriving group to attach his or her lock prior to or immediately after the previous TGR removed his or her lock. Both TGRs will witness the transfer of energy isolation control and note the transfer in the task documentation.
  5. The current TGR shall verify energy isolation for the system.
- b. When LO/TO is to be handed over from one TGR to another while the work is continued

## Chapter 8.2, Lockout/tagout practices

by the same authorized employees, this does not constitute a shift change. However, the task documentation shall be annotated to document this transfer of energy isolation control.

1. Inform all authorized personnel working on the system of the impending transfer of LO/TO authority.
2. The departing TGR will remove his or her lock and the new TGR will attach his or her lock prior to the previous TGR removing his or her lock. Both TGRs will witness the transfer and note the transfer in task documentation.

## *Training and Audits*

### 14. Training for LO/TO

A competent person shall conduct LO/TO training and the training needs to follow the requirements of Chapter 4.1 of this handbook for conduct and documentation.

- a. **Initial training.** Each employee involved in LO/TO or energy control as described in the bullets below shall be trained in the purpose and scope of the LO/TO program, recognizing hazardous energy sources and the methods and means necessary for energy isolation, and using the LO/TO procedures. Training for the three types of employees (**authorized**, **affected**, and **other**) is based on the relationship of that employee's job to the equipment being locked out or tagged out as follows:
  1. *If you are an **authorized employee** (you LO/TO and service or maintain equipment), your training shall cover details about the type and magnitude of the hazardous energy sources present in the workplace and the methods and means necessary to isolate and control energy sources.*
  2. *If you are an **affected** or **other employee** (you operate or use the machines), your training shall cover: recognizing when the control procedure is in place, understanding the purpose of the procedure, and understanding the importance of not attempting to start up or use equipment that has been locked out or tagged out.*
- b. **New-hire training.** If you are a new employee, you shall attend LO/TO training before doing any tasks that could expose you to energy hazards. Your supervisor shall tell you if you require LO/TO training when you are first assigned to work.
- c. **Retraining.** As an authorized employee, you require retraining at least every 2 years or:
  1. When there is a change in LO/TO or energy control procedures.
  2. *Whenever a periodic inspection reveals, or whenever the employer has reason to believe, that there are deviations from or inadequacies in his or her knowledge or use of the LO/TO or energy control procedures.*

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**15. Periodic audits of JSC's LO/TO program**

Each organization or contractor is responsible for continually monitoring and periodically auditing (at least annually) its LO/TO and energy control programs. The following requirements apply:

- a. The audit shall follow the requirements of 29 CFR 1910.147 (c) (6) and be documented.
- b. The Safety and Test Operations Division shall audit JSC's LO/TO program at least annually by inspecting organization and contractor documentation to ensure that all effected employees understand and are following the program.
- c. The Responsible Account Executive shall review any deviations noted on the audit and forward them to the responsible organization or contractor for correction.

# Chapter 8.5

## Lifting operations and equipment safety

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### *This could be you . . .*

*A crane load fell 3 feet from a 20-ton overhead crane hook. The operator was concentrating on the load itself and not on the path of travel. A section of the hoist rope hung up on an air handler pulley cover in the path of travel. The hoist rope unseated itself and dropped the load. The crane had to be shut down, repaired, and inspected before it could be used again.*

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### 1. Applicability of this chapter

You are required to follow this chapter if you manage, operate, service, or maintain lifting equipment as described in paragraph 2 below. Paragraph 15 lists the responsibilities of organizational directors, program managers, contract project managers, the Center Operations Directorate, the Safety and Test Operations Division, and the program offices.

### 2. What this chapter covers

This chapter covers minimum safety requirements for operating any mechanical device designed for lifting or lowering, and supplements the requirements in NASA-STD 8719.9, “Standard for Lifting Devices and Equipment,” ~~and JPD 8719.1, “JSC Material Handling Policy.”~~ It applies to overhead and mobile cranes, powered industrial forklift trucks, manually operated material handling equipment, and commercially owned cranes used at JSC.

### *Requirements for lifting operations and equipment safety*

### 3. Requirements for lifting equipment and operating procedures for lifting equipment

You shall follow these requirements for lifting:

- a. All lifting equipment and operating procedures for lifting equipment shall at least meet the requirements for “noncritical lifts” in NASA-STD 8719.9, “Standard for Lifting Devices and Equipment,” ~~JPD 8719.1, “JSC Material Handling Policy,”~~ and other requirements listed in this chapter. NASA-STD 8719.9 covers requirements for design, testing, inspection, maintenance, operation, personnel certification and marking requirements for lifting devices and associated equipment used to support NASA operations.
- b. Use ~~the pre-lift checklist in JPD 8719.1 and use~~ JSC Form 941, “Pre-Lift Checklist,” to plan and evaluate your lifting operations.

## **Part 8, Safety and health practices for manufacturing, repair, and maintenance**

- c. Use only electric powered lifting equipment inside buildings to prevent carbon monoxide accumulations. The Safety and Test Operations Division and the Clinical Services Branch shall approve any proposed indoor use of combustion-engine-powered equipment. Pay special attention to the outdoor placement and location of combustion-powered equipment to prevent the entrainment of carbon monoxide and other combustion products into JSC buildings, tunnel system, structures, etc.

### **4. Requirements for critical lifts**

Critical lifts involve lifting and lowering special high-dollar items, such as spacecraft, one-of-a-kind articles, or major facility components whose loss would have serious program impact. Critical lifts also include operations with personnel and equipment safety concerns beyond normal lifting hazards. The following requirements apply to critical lifts:

- a. Critical lifts shall also follow the requirements for “critical lifts” in NASA-STD 8719.9.
- b. Safety personnel shall monitor critical lifts to ensure that they follow all of the requirements in NASA-STD 8719.9.

### **5. Commercially owned cranes**

Commercially owned cranes are contractor- or subcontractor-owned, -rented, or -leased cranes. Critical lifts and cranes shall meet the following requirements:

- a. Follow the requirements in paragraph 4 above.
- b. Critical lift cranes shall meet OSHA requirements and ASME B30.5, “Mobile and Locomotive Cranes.”
- c. Before using a crane for a lift, you shall provide the Safety and Test Operations Division with the following information:
  - 1. Type of crane and capacity.
  - 2. The kind of lift (critical or noncritical) that the crane will make.
  - 3. The item to be lifted, the weight of the item, and the location of the lift.
  - 4. The purpose of the lift (task).
  - 5. The schedule, estimated start and completion.
  - 6. Any other pertinent information to include the crane’s load chart and a pre-lift checklist as described in ~~IPD 8719.1 and~~ JSC Form 941, “Pre-Lift Checklist.”

### **6. Requirements for powered industrial forklift trucks**

If you use a forklift, you shall follow these requirements:

- a. Make sure forklift trucks meet the design and construction requirements established in ASME B56.1, “Safety Standard for High Lift and Low Lift Trucks,” and in 29 CFR 1910.178, “Powered Industrial Trucks.” Chapter 12 of NASA-STD 8719.9 lists safe operating requirements for powered industrial trucks (forklifts).

## Chapter 8.5, Lifting operations and equipment safety

- b. Inspect the forklift per paragraph 12.4 of NASA-STD 8719.9 and document periodic inspections per subparagraph 12.4.7.
- c. Whenever possible, use non-CO-producing equipment such as electric-powered equipment, lifts, or forklifts inside enclosed or semi-enclosed areas. Never allow CO-producing motors to idle in enclosed or semi-enclosed areas. The Safety and Test Operations Division and the Clinical Services Branch shall approve any proposed indoor use of combustion-engine-powered equipment. If approval is granted, the Clinical Services Branch may require CO monitoring and exhaust ventilation. Additionally, if approval is granted, coordinate with the facility manager for work scheduling and occupant notifications and with the Fire Protection Services for Fire Alarm Outages where engine exhaust could activate smoke detectors. Pay special attention to the outdoor placement and location of combustion-powered equipment to prevent the entrainment of CO and other combustion products into JSC buildings, tunnel system, structures, etc.
- d. Charge batteries only in well-ventilated areas that meet ASME 56.1 and National Fire Protection Association Standard 505. Keep vent caps in place to avoid electrolyte spray when charging batteries of electric forklifts. Make sure that vent caps are functioning.
- e. If you use forklift extensions; you shall:
  - 1. Follow ASME 56.1.
  - 2. Use only manufacturer-approved extensions.
  - 3. Follow the manufacturer's recommendations.
  - 4. Uniquely identify the extensions.
  - 5. Use only a professionally modified forklift's load chart.

### 7. Requirements for other lifting equipment

You shall follow these requirements:

- a. Use other lifting equipment such as low-lift pallet trucks, hand trucks, man lifts, aerial platforms, and dollies only for the purpose intended by the manufacturer.
- b. Never operate this equipment unless you have been trained and certified by the proper authority.
- c. Follow the manufacturer's instructions and the appropriate chapters of NASA-STD 8719.9.

### 8. Possible issues during lifting operations

If you will handle any of the materials on this list, you shall follow the requirements referenced before starting the lifting operations.

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<i>For handling and storing . . .</i>	<i>Follow this standard . . .</i>
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Hazardous materials

Chapter 5.1, "Fire safety," and Part 9, "Safety and health practices"

## Part 8, Safety and health practices for manufacturing, repair, and maintenance

	for hazardous materials,” of this handbook.
Flammable liquids and gases	MSDSs and other procedures found in Chapter 5.1 of this handbook.
Cryogenic materials	Chapter 6.5, “Cryogenic materials and gases: how to work with them safely,” of this handbook.
Explosives and propellants	Chapter 9.5, “Explosives and propellants safety,” and Chapter 9.1, “Hazardous materials safety and health,” of this handbook. Appropriate paragraphs of NASA-STD 8719.9.

### 9. Requirements for slings and rigging equipment

Slings and rigging equipment shall meet the requirements in NASA-STD 8719.9. These include:

- a. Testing per paragraph 10.3.
- b. Inspection per paragraph 10.4 and supporting documentation per subparagraph 10.4.7.

### 10. Precautions for moving or operating a mobile crane

If you are in charge of moving or operating a mobile crane, you shall follow these requirements as well as the requirements in NASA-STD 8719.9, paragraph 5.7:

- a. Determine the path of travel and inspect it for hazards before the operation begins. Make sure clearances along the path of travel are adequate. Pay special attention to the following:
  1. Power lines – keep them clear of the crane at all times
  2. Personnel or objects in the crane’s path of travel
  3. Weight limits for the roadway or bridges
- b. Appoint a person responsible for determining and controlling the safety of the operation. These responsibilities include positioning of the crane and the load, boom extension and radius, ground support, travel route, and speed of movement.
- c. Hold a pre-departure crew safety meeting. Discuss the route and any hazards or conditions that the crane might encounter; such as; proximity of overhead power lines, close vertical or horizontal clearances, speed limits, planned stops, escort positions, and other special instructions. Make sure that no one other than required operating personnel are permitted on the equipment being moved.
- d. Make sure that safe load capacities, operating speeds, and other essential data are posted in or on equipment being driven or transported.
- e. Take these actions when moving a crane:
  1. Place flags and warning signs on the crane or vehicle before moving it with a secondary vehicle.



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2. Avoid sudden starts and stops.
3. Stop if you encounter overhead power lines that appear to be too close and make sure you can clear them safely with a 10-foot space or a verified de-energized line. Note that the clearance distance will change as a function of the line voltage. Ten feet is for at or less than 50,000 volts. Treat all overhead lines as energized until you are certain it is safe to proceed.
- f. Maintain at least a 2-foot clearance between the crane boom or jib and nearby walls, overhead trestles, columns, or other structures.

### 11. Requirements for working under a suspended load

OSHA requirements prohibit putting people under suspended loads. The Department of Labor approved an alternate standard for NASA to allow employees to work under suspended loads if certain conditions are met. However, you are discouraged from putting workers under suspended loads unless absolutely necessary to fulfill NASA's mission. This includes multiple load lifts (Christmas tree loads) because this practice requires personnel to work under or near suspended loads. You shall follow these requirements:

- a. Follow the requirements in Appendix A of NASA-STD 8719.9 if working under a suspended load is necessary.
- b. The Director, Safety and Mission Assurance, shall approve all work under a suspended load. To get approval, send your request and all documentation required by Appendix A of NASA-STD 8719.9 to the Safety and Test Operations Division.

### *Other requirements and responsibilities*

### 12. Variances to lifting requirements

To get a variance to any lifting requirement, including equipment design requirements, submit a variance request as described in Chapter 1.4, "Written Safety and Health Program," of this handbook. The Safety and Mission Assurance Office will forward your request to the Center Director or NASA Headquarters as needed. Paragraph 1.7 of NASA-STD 8719.9 lists NASA's policy for getting a variance (waiver or deviation) to lifting requirements. JSC's Center Director may approve some variances to NASA-STD 8719.9. ~~For critical lift operations that don't meet NASA-STD 8719.9, follow Attachment 1 of JPD 8719.1, "JSC Process for Critical Operations Not Conforming to NASA-STD 8719.9."~~

### 13. Training and certification requirements for operating lifting equipment

Operators and crew members shall meet the training and certification requirements in NASA-STD 8719.9 and Chapter 5.8, "Hazardous operations: safe practice and certification," of this handbook. You may arrange safety-related training through the JSC Safety Learning Center or arrange training on your own as described in Chapter 4.1, "Program Description"

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(for safety and health training), of this handbook. Consult your organization's policies and processes for certification.

### 14. Other requirements

As an operator or crew member, you shall follow these requirements as well as this chapter:

a. NASA-STD 8719.9

~~b. JPD 8719.1, "JSC Material Handling Policy."~~

~~c. 29 CFR 1910 Subpart N, "Material Handling and Storage"~~

~~d. JSC 07877, "Certification of Operators and Crew Members in Lifting Program Hardware"~~

~~e. NSTS 5300.4, "Safety, Reliability, Maintainability, and Quality Provisions for the Space Shuttle Program"~~

~~f. JSC 08114, "Shuttle Program Requirements for Periodic Certification of Material Handling Equipment and Operating Personnel"~~

### 15. Other responsibilities for lifting operations and equipment safety

The following organizations have responsibilities for lifting operations:

a. As a **director, program manager, or contract project manager**, you are responsible for:

1. Evaluating all lifting operations in your organization and making informed decisions on the risks they pose.
2. Determining which lifting operations in your organization are critical. You may delegate the authority for determining critical lifts, but you shall do it in writing.

b. The **Center Operations Directorate** is responsible for:

1. Preparing and maintaining up-to-date lists of all overhead cranes and fixed hoists.
2. Developing detailed inspection and test procedures, and test criteria for each item listed.
3. Carrying out a program to periodically inspect existing and permanently installed handling and lifting equipment.
4. Supervising the adjustment or modification of all cranes and hoists.
5. Keeping inspection and recertification records as described in this chapter.
6. Keeping records of all material-handling equipment used for critical lifts as defined in NASA-STD 8719.9.
7. Evaluating the adequacy of newly purchased handling and lifting equipment for permanent installation. This includes coordinating a review of design specifications,

## Chapter 8.5, Lifting operations and equipment safety

manufacturing controls, and operational acceptance testing to make sure that the equipment satisfies NASA-STD 8719.9.

8. Developing processes to identify critical lifting operations, lifting devices, and equipment that shall meet critical lift requirements. Get input from facility, program, user, safety, and quality assurance personnel. Document the results of the process and have it approved as a minimum, by the Director, Safety and Mission Assurance.
9. Making sure JSC has documentation, procedures, and controls in place to ensure that leased, owned, or rented special-purpose mobile equipment is adequate for its intended use and meets requirements that apply.
- c. The ***Safety and Test Operations Division*** is responsible for reviewing lifting operations and certifications to ensure that all requirements are being met.
- d. ***Program offices*** are responsible for making sure contracts require contractor-directed lifting operations to meet:
  1. JSC 08114, “Shuttle Program Requirements for Periodic Certification of Material Handling Equipment and Operating Personnel”
  2. NASA-STD 8719.9



# Chapter 8.6

## Power and hand tool safety

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### ***This could be you . . .***

*A maintenance worker was severely burned while using a power tool in a flammable atmosphere.*

*A machine shop worker wasn't wearing eye protection and received an eye injury from flying metal chips.*

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#### **1. Applicability of this chapter**

You are required to follow this chapter if you use any type of power or hand tool.

#### **2. Training requirements for this chapter**

You shall have training in safe operating practices for each power tool you use. See Chapter 4.1, "Program Description" (for safety and health training), of this handbook for more requirements on training. Training shall include the hazards of the tool in the configuration it will be used, the manufacturer's operating instructions, and any other safe operating practices which shall be readily accessible to anyone who uses the tool.

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#### **3. PPE for use with power and hand tools**

You shall wear eye protection when operating power and hand tools, including tools, such as screwdrivers, pliers, and wrenches. Use hearing protection when required. Some powered hand tools may require the use of vibration-damping gloves. Use other PPE as required by the Job Hazard Analysis. See Chapter 5.6, "Personal protective equipment," for more requirements on PPE.

#### **4. Safety devices for using power tools**

To prevent injury you shall:

- a. Never remove equipment guards and other safety devices for any purpose other than necessary maintenance or adjustments, and only with de-energized equipment.
- b. Shield power tool switches against accidental tripping or activation. Use "dead man" switches that require continuous pressure for operation as required by 29 CFR 1910.243, "Guarding of Portable Powered Tools," paragraphs (a)(2), (i) and (ii).

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### **5. Protection from fire or explosion hazards**

To prevent fire or explosion:

- a. Never use electrically powered tools near flammable or combustible materials or in explosive atmospheres unless they are approved by the National Fire Protection Association Standard 70, “National Electric Code,” for the atmosphere where the tools are to be used.
- b. Use only non-sparking hand tools when working in hazardous locations found in National Fire Protection Association Standard 70, Article 500.

### **6. Safely using cords, hoses, and cables and preventing electrical shock**

To protect cords, hoses, and cables and prevent electrical shock, you shall:

- a. Place cords, hoses, and power supply cables for portable power tools overhead or in floor trenches, or cover them to reduce trip hazards and to protect the cables.
- b. Use only power cables that have a third wire unless the tool is double insulated.
- c. Use only cords, portable electric tools, and work lights that:
  1. Meet National Fire Protection Association Standard 70, Article 400, “Flexible Cords and Cables.”
  2. Are UL-listed.
- d. Never raise or lower power tools by their electric cords.
- e. Never use power tools with the grounding prong missing unless it is identified as double insulated, which does not require a ground wire and prong.
- f. Use a heavy-duty plug with a strain relief device when replacing a plug.
- g. Ground all exposed metal parts on portable electric tools with exposed metal parts according to National Fire Protection Association Standard 70, Article 250–45, “Equipment Connected by Cord and Plug.” Meet this requirement with the correct cords and plugs. The only exception to this requirement is that you may use UL-listed double-insulated power tools that have a double wire system.
- h. Use GFCIs to protect circuits, receptacles, or extension cords on the construction site.

### **7. Inspecting power tools**

If your organization uses power tools, you shall develop a written process to ensure that the power tools are inspected before each use that:

- a. Includes provisions to tag damaged or unsafe tools with JSC Form 1243, “Out of Service,” for repair or disposal.

## Chapter 8.6, Power and hand tool safety

- b. Provides for inspections that cover the following and any specific items in the manufacturer's instructions:
  - 1. Check the general condition of tool for any obvious defects or lack of maintenance.
  - 2. Make sure that the grounding prong is intact, that the cord is intact, that the strain relief is intact, and that the outer insulation of the cord is free of damage.
  - 3. Check grounds to ensure continuity.
  - 4. Make sure guards are in place and working.
  - 5. Make sure any accessories to the tool are in good working order.

### 8. Transporting hand tools

You shall:

- a. Never attempt to carry tools or materials in your hands while climbing a ladder.
- b. Use a hand line when you need to lift or lower tools or material to another level.
- c. Attend the tool lift or lower at both levels to keep from injuring other employees.

### 9. Using insulated hand tools

You shall use only properly insulated or UL-approved nonconductive tools when you work on or near live electrical parts. This restriction applies to tools such as the following:

- a. Fuse pullers
- b. Screwdrivers
- c. Pliers (all types)
- d. Wire-cutting devices
- e. Wire strippers
- f. Connector and lug crimping tools

**Note:** Working on or near energized circuits is highly discouraged and requires special training and authorization.

### 10. When to stop using striking hand tools

You shall:

- a. Never use hammer-struck or striking tools that are cracked, chipped, spalled, or "mushroomed."
- b. Immediately remove these tools (e.g., punches, chisels, metal stencils, stone drills, or hammers) from service and replace them.

## **Part 8, Safety and health practices for manufacturing, repair, and maintenance**

- c. Only use hammers designed for use with striking tools. Don't use carpenter hammers in the place of striking hammers.
- d. Remove hammers and other tools from service if they have wood or fiberglass handles that are split, cracked, loose, or defective in any way.

## **11. Other standards to follow**

In addition to the requirements of this section, you must follow hand and portable powered tools and equipment requirements in the following OSHA standards that apply:

- a. 29 CFR 1910.241, "Definitions"
- b. 29 CFR 1910.242, "Hand and Portable Powered Tools and Equipment, General"
- c. 29 CFR 1910.243, "Guarding of Portable Powered Tools"
- d. 29 CFR 1910.244, "Other Portable Tools and Equipment"
- e. 29 CFR 1926.300–307 (for construction)



# Chapter 8.7

## Ladders, scaffolds, and elevated platforms: how to work with them safely

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### ***This could be you . . .***

*A worker was seriously injured when he fell about 20 feet from a ladder. He was the only person in a remote facility, and no one knew that he was there inspecting some pipes. He walked the ladder along the elevated piping to see additional sections and caused the ladder to fall. He had to crawl to a nearby area to get help.*

*Two workers miraculously survived but were permanently injured when the suspended scaffolding that they had improperly set up fell approximately 40 feet with them on it. They had the manufacturer's instruction and operation manual, but failed to read or apply it in the setup. They weren't experienced with suspended scaffolding, but had been given the task to assemble and use it.*

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### **1. Applicability of this chapter**

You are required to follow this chapter if you are a JSC civil service, contractor, or subcontractor employee who constructs, maintains, or uses:

- a. Ladders
- b. Scaffolds
- c. Safety nets
- d. Elevated platforms

Fall protection is required whenever you work over 4 feet above the ground doing general industry work, 6 feet above the ground doing construction work, or 10 feet above the ground on scaffolding. For more information, see Chapter 5.6, "Personal protective equipment," of this handbook. Fall protection is not required for short-term quick jobs from a ladder.

### **2. What this chapter covers**

This chapter covers the minimum requirements for constructing, erecting, testing, assembling, using, disassembling, lowering, maintaining, or storing ladders, scaffolds, safety nets, or elevated platforms.

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### *Requirements for ladders*

#### 3. Requirements for using portable ladders

Ladders are a means of allowing you to get from one work level to another. They aren't designed as a platform to work from for long periods of time. You may do short-term or quick jobs, such as changing a light bulb or connecting fixture wiring, from a ladder. You shall:

- a. Do longer-term or more complex jobs, such as changing out equipment, from work platforms such as scaffolding or man-lifts.
- b. Document the reason that you can't use a work platform if you must do any of these longer-term jobs with a ladder. Get approval for not using a work platform from the appropriate safety representative and the Safety and Test Operations Division. Also, describe the specifics of the fall protection system that you will use to protect yourself on a ladder.
- c. Always follow the manufacturer's recommendations when working with ladders, including Type I industrial stepladders, Type II commercial stepladders, and extension ladders.
- d. Follow 29 CFR 1910.25, "Portable Wood Ladders," 29 CFR 1910.26, "Portable Metal Ladders," and 29 CFR 1926.1053, "Ladders" (for construction).
- e. Maintain three points of contact with the ladder when ascending or descending (one hand and two feet, or two hands and one foot) and keep the center of your body between the ladder rails.
- f. Place ladders to prevent slipping, tie them off, or have someone hold the ladder in a steady position.
- g. Never have more than one person on a ladder unless it is specially designed for this use.
- h. Adjust extension ladders while standing at the base of the ladder and make sure that the locks are properly engaged. Don't make adjustments while standing on the ladder.
- i. Erect two-section extension ladders so that the upper section is resting on the bottom section. The minimum overlap for the two sections are listed below:

<i>Size of Ladder (feet) . . .</i>	<i>Overlap (feet) . . .</i>
Up to and including 36	3
Over 36 up to and including 48	4
Over 48 up to and including 60	5

- j. Extend the ladder a minimum of 3 feet above the point of support when you need to access a roof or other top surface.

## **Chapter 8.7, Ladders, scaffolds, and elevated platforms: how to work with them safely**

### **k. Never:**

1. Use ladders in a horizontal position as platforms, runways, or scaffolds.
  2. Place them in front of doors opening toward the ladder unless the door is blocked, locked, or guarded. Don't lock an EXIT door.
  3. Place the ladder on boxes, barrels, or other unstable bases.
  4. Splice together short ladders to make long sections.
  5. Use ladders made by fastening cleats across a single rail.
  6. Use them as guys, braces, or skids, or for other than their intended purpose.
  7. Use the top or top step of stepladders as a step.
  8. Use portable stepladders longer than 20 feet.
  9. Climb on the bracing on the back legs of stepladders.
  10. Use a closed stepladder as a vertical ladder.
  11. Use metal ladders in close proximity to areas containing electrical circuits.
  12. Use the middle and top sections of sectional or window cleaner ladders unless you equip them with safety shoes.
- l. Use care in safely placing, securing, or holding a ladder being used on oily, metal, concrete, or slippery surfaces. Nonslip bases may not be adequate.

## **4. Ladder inspection**

You shall inspect ladders before each use and inspect and test any ladder involved in an incident such as tipping over or one exposed to extreme heat (fire) for deflection and loss of strength and follow these requirements:

- a. In addition, supervisors or designees shall also inspect each ladder at least yearly. Document each yearly inspection on an inspection tag that shows the inspector's initials and date for next inspection. Use off-the-shelf inspection tags that fit into holders that are attached to the ladder or a similar method, such as a tape tag, for inspection documentation. You can get these tags in quantities of fewer than 20 from the Safety and Test Operations Division by calling x378170394 or x34353. Take any ladders out of service that have defects with an "Out of Service" tag (JSC Form 1243). Make sure defective ladders are repaired or destroyed.
- b. Ladder inspections shall cover the following and any additional items in the manufacturer's instructions:
1. Overall condition and maintenance
  2. Tight joints between the steps and side rails
  3. Securely attached fittings
  4. Movable parts – must move freely

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5. All rung and hardware connections and rivets for shearing
6. Loose or broken steps or rungs
7. Excessively dented rungs
8. Broken, split, or cracked uprights, braces, steps or rungs
9. Rail dents or bends
10. Loose nails, screws, bolts, rivets, rung-to-side-rail connections, or hardware connections
11. Missing, broken, or damaged safety shoes, nonslip bases, casters/wheels, or locking devices
12. Loose, bent, or broken hinges or spreaders on stepladders
13. Defective locks on extension ladders
14. Deteriorated or broken ropes or sheaves on extension ladders
15. General serviceability

### **5. How to keep portable ladders safe**

You shall always follow the manufacturer's recommendations when working with ladders and:

- a. Follow 29 CFR 1910.25, 29 CFR 1910.26, and 29 CFR 1926.1053 (for construction).
- a. Lubricate metal bearings of locks, wheels, and pulleys frequently.
- b. Equip bases of portable ladders with nonskid material or safety shoes of strong design.
- c. Keep rungs free of grease, oil, or other foreign materials.
- d. Apply a protective coating, such as varnish, to ladders that are subjected to certain acid or alkali solutions. Don't apply opaque paint to ladders; it would hide defects.
- e. Use portable rung ladders within reinforced rails only with metal reinforcement on the underside. Use this kind of ladder with great care near electrical conductors.

### **6. Requirements for working with fixed ladders**

You shall:

- a. Always follow the manufacturer's recommendations when working with fixed ladders.
- b. Design, build, use, and maintain fixed ladders as described in 29 CFR 1910.27, "Fixed Ladders."
- c. Face the ladder when climbing or descending.
- d. Raise or lower tools or other equipment with lanyards, tool belts, or aprons. Don't carry tools in your hands when ascending or descending a ladder.

## Chapter 8.7, Ladders, scaffolds, and elevated platforms: how to work with them safely

- e. Allow only one person on a ladder section at a time.

### *Requirements for scaffolds*

#### **7. Description of, and standards that apply to, scaffolds**

A scaffold is any **temporary** elevated platform (supported or suspended) and its supporting structure (including points of anchorage) used for supporting employees or materials or both. Two OSHA standards apply to scaffolds:

- a. 29 CFR 1926, Subpart L, “Scaffolding,” applies to scaffolds used in construction work. Construction work is any work for construction, alteration, or repair, including painting and decorating.
- b. 29 CFR 1910.28, “Safety Requirements for Scaffolding,” applies to any nonconstruction work.

#### **8. Inspecting and maintaining scaffolds**

You shall:

- a. Design, build, erect, and maintain scaffolds as described in 29 CFR 1910.28 and 29 CFR 1926, Subpart L (for construction).
- b. Have trained scaffolding-competent persons designated by the scaffold manufacturer or employer. Never inspect, repair, or maintain scaffolds used in construction unless you are trained as described in subparagraph 18.d of this chapter.
- c. Maintain scaffolds and other devices in a safe condition. Correct any defects, unsafe conditions, or noncompliance immediately before further use. Never use any broken, bent, excessively rusted, altered, or otherwise structurally damaged frames or accessories.
- d. Never use scaffolding components from different manufacturers or systems together, unless specifically authorized to do so by the scaffolding manufacturer.
- e. Inspect scaffold equipment for defective parts and structural integrity at least twice a year, before each assembly, and daily during use. Your supervisor, safety representative, or the Safety and Test Operations Division may help you in these inspections. Record, date, and maintain the inspection reports in the office of the responsible organization.
- f. Inspect wire ropes, fiber ropes, slings, hangers, platforms, and other supporting parts for defects before each installation and daily during use.
- g. Periodically inspect all welded frames and accessories. Also inspect any maintenance, such as painting or minor corrections, authorized by the manufacturer before further use.

## **Part 8, Safety and health practices for manufacturing, repair, and maintenance**

- h. Remove defective equipment from service immediately. Your designated scaffolding-competent person, safety representative, or supervisor shall put a WARNING - DO NOT OPERATE tag (JSC Form 19A) on the equipment until it is repaired or destroyed.

### **9. Erecting scaffolds**

Observe the requirements as described in 29 CFR 1910.28; 29 CFR 1926, Subpart L (for construction); the manufacturer's recommended work practices; and the following requirements for operations involving scaffolds:

- a. Use only designated competent, experienced personnel to erect scaffolds or to supervise the erection of scaffolds. Never erect, disassemble, or move scaffolds used in construction unless you are trained as described in subparagraph 18.d of this chapter.
- b. Make sure the footing or anchorage for scaffolds is sound, rigid, and capable of supporting the maximum intended load without settling or displacement. Never use unstable objects such as barrels, boxes, loose brick, or concrete blocks to support scaffolds or planks.
- c. Overlap all planking or platforms (minimum 12 inches) or secure them from moving.
- d. Provide an access ladder or equivalent safe access on scaffolds that have built-in ladders that decrease in width.
- e. Extend scaffold planks over their end supports not less than 6 inches and not more than 18 inches.
- f. Make sure the poles, legs, or uprights of scaffolds are plumb and securely and rigidly braced to prevent swaying and displacement.
- g. Make sure materials being hoisted onto a scaffold have a tag line.
- h. Provide overhead protection for personnel on or near a scaffold that is exposed to overhead hazards.
- i. Install guardrails and toe boards at all open sides on all scaffolds more than 10 feet above the ground or floor. Provide scaffolds with a screen between the toe board and the guardrail, extending along the entire opening, consisting of No. 18-gauge U.S. Standard Wire ½-inch mesh or the equivalent where persons are required to work or pass under the scaffolds.
- j. Set independent pole scaffolds as near to the wall of the building as practical.
- k. Separate the area under scaffolding or elevated work from other areas by suitable barricades to prevent personnel travel under the platform and to protect from falling objects.
- l. Install outriggers on scaffolding as directed by the manufacturer, or whenever the height of the scaffold system exceeds four times the minimum base width.
- m. Check for and avoid getting too close to electrical equipment; for example, crane rails.

## **Chapter 8.7, Ladders, scaffolds, and elevated platforms: how to work with them safely**

### **10. Requirements for working on any scaffold**

To use scaffolding, you shall follow the manufacturer's recommended work practices as well as 29 CFR 1910.28 or 29 CFR 1926, Subpart L (for construction), and NEVER:

- a. Assemble or disassemble scaffold used in construction unless you are trained as described in subparagraph 18.c of this chapter.
- b. Work on scaffolds used in construction unless you are trained as described in subparagraph 18.d of this chapter.
- c. Alter or move a scaffold horizontally while in use or occupied unless it is specifically intended for that purpose.
- d. Exceed the intended working load for the scaffold.
- e. Work on scaffolds during storms or high winds or if the scaffold is covered with ice or snow. Remove ice and snow and sand from the planking to prevent slips.
- f. Accumulate tools, materials, and debris in quantities that could cause a tripping hazard.
- g. Use "shore" or "lean-to"-type scaffolds.

### **11. Requirements for working with suspended scaffolding**

You shall observe the manufacturer's recommended work practices; 29 CFR 1910.28 and 29 CFR 1926, Subpart L (for construction); and the following requirements for operations involving suspended scaffolding:

- a. If you erect, or supervise the erection of, suspended scaffolding, you shall be trained and designated by the scaffolding manufacturer or employer as a suspended scaffold-competent person. Never erect, disassemble, move, or use scaffolds in construction unless you are trained as described in subparagraph 18.d of this chapter.
- b. Use wire or fiber rope for scaffold suspension that is capable of supporting at least six times the intended load. Use thimbles in ropes attached to securing points to support the scaffold (both primary and secondary supports).
- c. Use wire-rope-supported scaffolding when acid solutions are used for cleaning buildings over 50 feet in height. Use only treated or protected fiber rope for or near any suspended scaffold work involving the use of corrosive substances or chemicals.
- d. Inspect all ropes, slings, hangers, platforms, and other supporting parts for defects, corrosion, or rusting before each installation and use. Replace wire ropes with six or more broken wires in any one lay of the wire rope. A "lay" is the distance it takes one strand to make a 360-degree wrap around the rope. Also replace damaged ropes or ropes in a deteriorated condition.
- e. Protect yourself while working in a suspended scaffold with a harness attached to an independently supported lifeline through a fall-arrest device (rope grab). Attach the lifeline to substantial members of the structure that are independent of the scaffolding.

## **Part 8, Safety and health practices for manufacturing, repair, and maintenance**

- f. Secure all suspended scaffolding portable components that support the scaffold (such as parapet clamps or hooks) with secondary tiebacks to substantial members of the structure.
- g. Allow only two workers (with their tools) on a suspension scaffold rated at a working load of 500 pounds and only three workers (with their tools) on a suspension scaffold rated at 750 pounds.
- h. Set up all suspended scaffolding portable components that support the scaffold (primary and secondary tiebacks) so that only one device is attached to a preformed exposed aggregate facade panel section.

### *Requirements for elevated platforms*

#### **12. Requirements for working with power-operated platforms**

You shall:

- a. Install, operate, use, maintain, and inspect power-operated platforms for exterior building maintenance as described in 29 CFR 1910.66, “Powered Platforms for Exterior Building Maintenance.” The requirements of this section don’t apply to firefighting equipment or to the vehicles with mounted aerial devices, except that the vehicle shall be a stable support for the aerial device.
- b. Never move, operate, repair, maintain, or inspect power-operated platforms used in construction unless you are trained as described in subparagraph 18.e of this chapter.
- c. Never disable any required safety device or electrical protective device, except when necessary during tests, inspections, and maintenance. Restore the devices to their normal operating condition immediately after completing such tests, inspections, and maintenance.
- d. Never operate powered platforms during severe adverse weather conditions as determined by your supervisor or the Safety and Test Operations Division.
- e. Make sure that each employee on the working platform has and uses a harness and lifeline as described in Chapter 5.6 of this handbook.
- f. Make sure that all powered platforms have an acceptance test to determine that all parts meet 29 CFR 1910.66 specifications and that all safety and operating equipment functions as required. Make a similar inspection and test after any alteration to an existing powered platform installation.

#### **13. Requirements for work with other elevated platforms**

You shall:

- a. Design, construct, test, operate, and maintain aerial devices, aerial ladders, articulating boom platforms, extensible boom platforms, and other types of vehicle-mounted



## **Chapter 8.7, Ladders, scaffolds, and elevated platforms: how to work with them safely**

elevating and rotating work platforms as described in 29 CFR 1910.67, “Vehicle-Mounted Elevating and Rotating Work Platforms.”

- b. Never move, operate, repair, maintain, or inspect elevated platforms used in construction unless you are trained as described in subparagraph 18.e of this chapter.
- c. Consider the following when operating aerial lifts close to, under, over, by, or near electric power lines:
  - 1. For lines rated at 50 kV or less, the minimum clearance between the lines and any part of the aerial lift shall be at least 10 feet.
  - 2. When the lines are rated over 50 kV, the minimum clearance between the lines and any part of the aerial lift shall be at least 10 feet plus 0.4 inch for each kilovolt over 50 kV, or twice the length of the line insulator, but never less than 10 feet.
  - 3. These requirements don’t apply if the work is performed from an aerial device insulated for the work and the work is performed by either telecommunications employees, line-clearance tree-trimming employees, or electric utility employees; or where the electric power transmission or distribution lines have been de-energized and visibly grounded at the point of work, or where insulating barriers, which are not a part of or an attachment to the aerial lift, have been erected to prevent physical contact with the lines.
- d. Treat any overhead wire as energized until the person owning the line, his/her representative, or the electrical utility authorities verify to you that it is de-energized and locked and tagged out as per the JSC NASA LO/TO specifications.
- e. Use proximity warning devices, but not in lieu of meeting the requirements contained in subparagraph a above.
- f. Notify the owner of the lines or his or her authorized representative and provide them with all pertinent information before beginning operations near electrical lines. In the case of JSC, the JSC Plant Engineering Division shall notify the utility company before starting work near electrical lines. Also, notify the owner of the electrical lines when the work is completed.

### **14. Requirements for working with ladder and tower trucks**

Before you move the truck for highway travel, you shall lower aerial ladders in the traveling position. Do this by locking the device above the truck cab and the manually operated device at the base of the ladder. You may also use other equally effective means such as cradles that prevent rotation of the ladder in combination with positive-acting linear actuators.

### **15. Requirements for working with elevating and articulating boom platforms**

Observe the manufacturer’s recommended work practices and the following requirements when operating extensible and articulating boom platforms. You shall:

## **Part 8, Safety and health practices for manufacturing, repair, and maintenance**

- a. Never move, operate, repair, maintain, or inspect elevating and articulating boom platforms used in construction unless you are trained as described in subparagraph 18.e of this chapter.
- b. Immediately test lift controls of elevating and articulating boom platforms before use to determine that the controls are in safe working condition.
- c. Make sure that only trained persons operate an aerial lift.
- d. Never belt off to an adjacent pole, structure, or equipment while working from an aerial lift.
- e. Always stand firmly on the floor of the basket. Never sit or climb on the edge of the basket or use planks, ladders, or other devices for a work position.
- f. Wear a body harness and a lanyard attached to the boom or basket.
- g. Never exceed boom and basket load limits specified by the manufacturer.
- h. Set brakes and position outriggers on pads or a solid surface. Install wheel chocks before using an aerial lift on an incline.
- i. Never move an aerial lift truck when the boom is elevated in a working position with workers in the basket, unless the equipment is specifically designed for this operation as described in 29 CFR 1910.66.
- j. Make sure that articulating boom and elevating boom platforms, primarily designed as personnel carriers, have both platform (upper) and lower controls.
  - 1. Upper controls shall be in or beside the platform within easy reach of the operator.
  - 2. Lower controls shall provide for overriding the upper controls.
  - 3. Controls shall be plainly marked as to their function.
  - 4. Never operate the lower level controls unless you have permission from the employee in the lift, except in case of emergency.
- k. Never wear pole climbers while doing work from an aerial lift.
- l. Never alter the insulated portion of an aerial lift in any manner that might reduce its insulating value.
- m. Inspect each boom before moving an aerial lift for travel to see that it is properly cradled and outriggers are in a stowed position, except for equipment specifically designed for this type operation in accordance with the manufacturer's recommended work practices or 29 CFR 1910.66.

### **16. When and how to use a safety net**

You shall follow 29 CFR 1926.502, "Fall Protection Systems Criteria and Practices," or the following requirements for safety nets:

## Chapter 8.7, Ladders, scaffolds, and elevated platforms: how to work with them safely

- a. Provide a safety net for workplaces where other means of fall protection such as scaffolding, ground-supported personnel-lifting devices, lifelines, or safety harnesses cannot protect a worker due to the conditions of the elevated work area. These conditions may include:
  1. Structural ironwork where there is no tie-off.
  2. Working above water surfaces.
  3. The height of the work area is such that using ladders or erecting scaffolding would be a greater risk.
  4. The area isn't accessible with ground-supported personnel-lifting devices.
- b. You may also use safety nets where there is a danger of items dropping from the workplace and endangering people below.

### *Other requirements for working at heights*

#### 17. PPE and clothing to use when using ladders, scaffolding, or elevating work platforms

You shall wear PPE consistent with the guidelines below. For more information on personal protective equipment, see Chapter 5.6 of this handbook.

<i>If . . .</i>	<i>You shall wear . . .</i>
Objects could fall on your head, you could bump your head, or you could come in contact with electrically energized equipment	Hard hats.
Objects could fall into or be blown into your eyes	Safety glasses with side protection, goggles, and a face shield if required (such as for grinding).
You must lift sharp or pointed objects by hand	Gloves.
You must lift heavy objects over your feet, or you may step on sharp or pointed objects	Industrial work shoes; safety toed or equipped with metatarsal protection (as needed).
You could fall	All items specified by the manufacturer's recommended work practices.  <b>Note:</b> Going from one level to another level on portable ladders does not require fall-protection equipment.
You are working in a suspended scaffold	A harness with a rope grab device attached to an independently supported lifeline.

## Part 8, Safety and health practices for manufacturing, repair, and maintenance

<i>If . . .</i>	<i>You shall wear . . .</i>
You are working in a boom lift, a scissor lift, or an aerial platform	A harness secured to the platform, unless specifically waived by the manufacturer's recommended work practices.  <b>Note:</b> While on powered platforms with hand or guardrails in place, you shall be secured in the platform and keep your feet on the deck to prevent fallout in case the platform tips.
You are using a ladder as a work platform for longer-term or more complex jobs (short-term jobs such as changing a light bulb or adjusting an air-conditioning ducting mixing chamber are acceptable)	A fall-protection system and document the reasons why you can't do the work on a standard platform.
You work 4 feet above grade (6 feet in construction) without a fall-protection system in place	Independently supported lifelines properly connected to an anchorage rated at 5,000 pounds or more, harness, and shock absorber (if needed to limit impact force to 1,800 pounds), or a work-positioning system.

### 18. Required training before using ladders, scaffolding, or elevated work platforms

Your training shall cover the requirements recommended by the manufacturer of the equipment that you intend to use. See Chapter 4.1, "Program Description" (for safety and health training), of this handbook for more requirements on training. If you:

- a. Supervise the construction, erection, testing, assembly, use, disassembly, lowering, maintenance, or storage of ladders, scaffolds, or work platforms or do these functions unsupervised, you shall be trained in the safe work practices described in this chapter and the referenced OSHA standards.
- b. Do any of the functions listed in a above, you shall be specifically designated and classified by your employer as being competent and qualified due to your:
  1. Knowledge and experience.
  2. Awareness of the hazards associated with the specific equipment in the specific environment.
- c. Work on any kind of scaffold used in construction, you shall have the Scaffold Users Training.
- d. Erect, disassemble, move, operate, repair, maintain, or inspect scaffolds used in construction, you shall be trained in the requirements of 29 CFR 1926.454(b), "Training Requirements," and Appendix D, Subpart L, of 29 CFR 1926.
- e. Move, operate, repair, maintain, or inspect any kind of aerial lift used in construction, you shall be trained in the requirements of 29 CFR 1926.453, "Aerial Lifts." Aerial lifts include the following:

## **Chapter 8.7, Ladders, scaffolds, and elevated platforms: how to work with them safely**

1. Power-operated platforms
2. Other elevated platforms
3. Extensible and articulating boom platforms



# Chapter 9.1

## Hazardous materials safety and health

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### ***This could be you . . .***

*A diesel spill occurred in a parking lot when a personal diesel container in the back of a pickup truck tipped over and leaked.*

*Two workers cleaning an oxidizer storage tank were killed when the tank exploded due to a reaction between the cleaning agent and residual oxidizer.*

Workers released a cloud of oxidizer that drifted outside the downwind safety zone because they unknowingly released too much oxidizer.

### **1. Applicability of this chapter**

You are required to follow this chapter if you purchase or handle hazardous materials or control areas where hazardous materials are used or stored at JSC or JSC field sites.

### **2. What this chapter covers**

This chapter covers the purchase, use, handling, transporting, and restrictions of hazardous materials.

### **3. What are hazardous materials?**

A hazardous material is anything that can be a danger by contact, inhalation, consumption, or impacting the environment. These materials may include:

- a. Chemicals as listed in various regulations (see <http://sd.jsc.nasa.gov/omoh/scripts/OccupationalHealth/HazardousMaterials.aspx>)
- b. Radioactive materials
- c. Explosives or any pyrotechnics
- d. Pesticides

### **4. What to do when you need to use a hazardous material that is a risk to health, safety, or the environment**

If you use or store, or plan to use or store, hazardous materials you shall:

- a. Complete a new or update an existing hazard analysis (see paragraph 6 below) for new materials or new uses of existing materials. Notify the Occupational Health Department before you use any hazardous materials for the first time or before using a hazardous material in a new or different way.

## Part 9, Safety and health practices for hazardous materials

- b. Request MSDSs from the manufacturer or supplier whenever you order a hazardous material. If they did not provide the MSDS for your hazardous material, contact them immediately for a copy. You may not use the material until you have an MSDS annotated with a “JSC MSDS Number” and have addressed the identified hazards. (See paragraphs 8 and 9 below.)
  - 1. Keep MSDSs up to date by having procedures for filing revised or newly acquired MSDSs from the JSC MSDS repository or supplier.
  - 2. Provide new or revised MSDSs to the Occupational Health Department.
  - 3. Keep a hard copy of your MSDSs readily available for employees in the work area.
- c. Review proposed purchases against the list of restricted and prohibited materials before starting a purchase request or supply requisition.
- d. Get a copy of the MSDS in advance to substantiate compliance with this requirement.
- e. Get a waiver before using any prohibited material or materials with a restricted use as described in paragraph 15 below.
- f. Contact the JSC RSO before purchasing radioactive materials (see Chapter 7.4 of this handbook).
- g. Review hazardous waste disposal requirements of residual, used, or contaminated material as well as empty containers to determine the cost impacts, environmental impacts, or regulatory restrictions. Regulations may require substitution of certain materials. For example, stratospheric ozone-depleting chemicals should be phased out under the Clean Air Act of 1990. See Chapter 5.8, “Hazardous operations: safe practices and certification,” of this handbook for more information on permits. See Chapter 4.1, “Program description,” for more information on safety and health training.
- h. Try to find a less hazardous material that will do the job within your quality standards.
- i. Purchase the smallest quantity necessary to do the job.
- j. Develop and maintain a list of hazardous materials in the JSC Hazardous Material Inventory Database. See Chapter 9.2, “Hazard communication,” of this handbook.
- k. Make sure that you and your employees are properly trained in the use and hazards of these materials before using them. See Chapter 9.2, “Hazard communication,” of this handbook.
- l. Use proper work practices and handling procedures.
- m. Use proper waste-handling practices such as labeling, segregating, and avoiding the mixing of different hazardous waste streams.
- n. Make sure that all hazardous materials are used properly and that necessary precautions are taken so that no harm is done to humans or the environment.
- o. Make sure that your subcontractors who use hazardous materials on site follow the requirements of this chapter if you are a prime contractor.



## Chapter 9.1, Hazardous materials safety and health

- p. Make sure your visiting scientists who use hazardous materials follow the requirements of this chapter.

### 5. Recycling

Recycling hazardous materials is another method of reducing cost and minimizing wastes while conserving natural resources. Before recycling hazardous materials, contact the Environmental Office to determine environmental requirements.

### *Planning to handle hazardous materials*

### 6. Planning to handle hazardous materials

If you are planning to handle hazardous materials, you shall complete a hazard analysis for each process that you control, or that is in your area, that uses toxic, reactive, flammable, radioactive, or corrosive chemicals. The hazard analysis will help to establish precautionary measures and help to determine the need for an emergency action plan (EAP). Obtain and use the most current MSDS(s) when performing the hazard analyses. The hazard analysis shall:

- a. Contain a listing of chemicals used in the process.
- b. Be updated whenever quantities increase or processes change.
- c. Address the failure mode of the spontaneous release such as a container failure without operations in progress.

**Note:** See Chapter 2.4, “Hazard Analysis,” and JSC 17773, “Preparing Hazard Analysis for JSC Ground Operations,” for instructions on completing the hazard analysis. Follow Chapter 3.3, “Process Safety Management,” and 29 CFR 1910.119 for process safety management of highly hazardous chemicals.

### 7. What to do with a completed hazard analysis

If your analysis shows hazards with an RAC of 1, 2, or 3 as described in Chapter 3.5, “Hazard Correction Tracking,” of this handbook, you shall:

- a. Prioritize control measures using this order: engineering controls, work practices, PPE, and administrative measures.
- b. Send a list of the hazards to the Occupational Health Department (SD3229) for review.
- c. Develop or modify your EAP to cover the actions that need to be taken to ensure employee safety during fires, hazardous material releases, or other emergencies that might occur in your area. Your EAP shall follow the requirements in Chapter 3.8, “Emergency Preparedness,” of this handbook.

## Part 9, Safety and health practices for hazardous materials

### *Obtaining and maintaining Material Safety Data Sheets*

#### **8. Responsibility for MSDSs at JSC**

The following applies to MSDSs:

- a. Line organizations who acquire hazardous materials shall obtain a current MSDS using the process in paragraph 9 below.
- b. The Occupational Health Department keeps the central repository of MSDSs for JSC and assists in obtaining, collecting, maintaining, and distributing MSDSs. An on-line database of these MSDSs is available on the Health Home page. You may contact the Occupational Health Department MSDS Coordinator at (281) 483-7512 for any questions that you may have about MSDSs.

#### **9. Ordering an MSDS**

To order an MSDS:

- a. First check the NASA/JSC MSDS Search for any MSDSs that are not in your files. If the MSDS is in the database and scanned into the system, you can print the MSDS directly off the screen.
- b. If the MSDS is in the database but is not scanned into the system, submit a completed JSC Form 277, "Material Safety Data Sheet Request Form" (Appendix 9A), to the Occupational Health Department MSDS Coordinator (SD3229). The MSDS Coordinator will contact you when the item has been scanned into the system.
- c. If the MSDS is not in the database, request a copy of the MSDS from the manufacturer or supplier of the product.
- d. If the MSDS in your work area is more than 3 years old, it may be outdated. Contact the manufacturer or supplier to determine whether a more current MSDS is available.
- e. Submit all new and updated MSDSs, along with a completed JSC Form 277, to the Occupational Health Department MSDS Coordinator (SD3229). This individual will assign a JSC MSDS Number and will contact you when the item has been scanned into the system.

### *Purchases of hazardous materials*

#### **10. Purchase requests for hazardous materials**

Both contractors and civil servants need to follow the requirements for purchasing hazardous materials in this chapter. You shall:

## **Chapter 9.1, Hazardous materials safety and health**

- a. State, on the purchase request, “MSDS REQUIRED. RECEIVING OFFICE: UPON RECEIPT OF MSDS, FORWARD ONE COPY EACH TO CENTRAL MSDS REPOSITORY AND TO USER.”
- b. Notify the Clinical Services Branch and the Environmental Office before you:
  1. Use any hazardous materials initially.
  2. Change the usage of any hazardous material.

### **11.The role of procurement in purchasing hazardous materials**

The following requirements apply:

- a. The Procurement Support Group shall:
  1. Support procurement in identifying contract requirements for safety concerns under JPR 1281.6, “Procurement.”
  2. Coordinate all procurements involving hazardous materials with the Clinical Services Branch to identify requirements that the supplier must follow and document. The Clinical Services Branch requires an MSDS (OSHA Form 174 or equivalent) to accompany the shipment.
- b. Procurements of any potentially hazardous material shall follow subpart 23.3 of the Federal Acquisition Regulations (FAR) and NASA FAR Supplement 18–23.3, “Hazardous Material Identification and Material Safety Data.”
- c. All procurement offices shall make sure that specific safety or health requirements are in purchase orders and contracts. Specifically, safety or health requirements will indicate whether an MSDS is necessary.

### **12.Responsibilities of the receiving office**

All receiving offices shall:

- a. Make sure that an MSDS accompanies all hazardous materials when specified on the purchase order.
- b. Confirm that each shipping container has a label that identifies the contents given on the MSDS, the manufacturer or distributor of the material, and the specific physical or health hazards cited in the MSDS.
- c. Send all MSDSs that accompany any shipments of materials to the Central MSDS Repository (SD3229). You shall keep copies of the original MSDS in the receiving office repository to be distributed later with the material.
- d. Make sure a copy of the MSDS accompanies all hazardous materials in storage and distribution either on site or off site. MSDSs shall be made available to receiving office employees on request.

## Part 9, Safety and health practices for hazardous materials

- e. Make sure receiving office employees are trained in the measures to take in the event of a spill or leak of hazardous materials.
- f. Immediately impound the material and contact the responsible forwarding office for correction if the MSDS is missing from the shipping documents. If an MSDS is already on file, the receiving office may add this MSDS to the shipping papers if the name and supplier of the material on the shipping container and the MSDS are identical. The exception to this is generic materials such as hydrochloric acid or caustic soda.
- g. Reject and return any shipment or transfer of hazardous materials if the supplier or forwarding office fails to provide an MSDS.

### *Requirements for safely handling hazardous materials*

#### 13. Safely handling and storing hazardous materials

If you have hazardous materials in your work areas, you shall also:

- a. Review the hazardous materials in your work area to:
  - 1. Reduce the quantity of the material.
  - 2. Reduce the chance of a fire, a spill, or an accidental release.
  - 3. Reduce hazardous waste.
- b. Take steps to eliminate or reduce the risks of hazardous materials. This includes substituting a less hazardous material, if possible, or writing work requests, as necessary, to install required engineering controls.
- c. Keep the proper fire extinguishers in the area. Contact the Safety and Test Operations Division for more information.
- d. Store hazardous materials in a manner consistent with manufacturer's recommendations and the Chemical Segregation and Storage Guide found on the Health Web page.
- e. Post appropriate warning signs within your work areas, and make sure that tanks and piping are labeled per ASME A13.1, "Scheme for the Identification of Piping Systems."
- f. Label all containers of hazardous materials within your work area as described in 29 CFR 1910.1200, "Hazard Communication Standard" (see Chapter 9.2 of this handbook).
- g. Use proper waste-handling practices, including waste segregation and disposal, for all processes that use hazardous materials per the Waste Segregation and Storage Guide found in JPR 8500.1, "Environmental Compliance Procedural Requirements."
- h. Make sure you have appropriate fire protection systems and fire extinguishers for the hazardous materials.

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- i. Make an assessment for the need for escape respirators in areas where hazardous materials are stored.
- j. Make sure chemical alarms and warning lights are operational as described in Chapter 6.12, “Local Hazard Chemical Alarms,” of this handbook.
- k. Assess the condition of hazardous materials in storage at least quarterly and remove those you determine to be unsuitable.

### *Restricted and Prohibited materials*

#### 14. Restricted and prohibited materials at JSC

JSC has decided that some products are too hazardous to handle and are prohibited for purchase, storage, or use. Other products are toxic or highly regulated and may only be used in limited applications or restrictions may apply. See ~~Attachment 9.1A, Appendix 9B, the following URL~~, for the list of restricted and prohibited chemicals: <http://sd.jsc.nasa.gov/omoh/docs/Restricted%20and%20Prohibited%20Materials.doc>

The following requirements apply:

- a. JM/Project Management Office shall maintain JSC SPECSINTACT to conform to the policy on restricted materials that may be used in construction, modification, or repair of facilities, specifically asbestos-containing materials (ACMs), PCBs, chlorofluorocarbons (CFCs) and hydro-chlorofluorocarbons (HCFCs), and mercury.
- b. If you are responsible for maintaining facilities or equipment, you shall specify “non-asbestos” products, undetectable concentrations of PCBs, “non-CFC”-containing equipment, or non-mercury equipment.

JSC is continually evaluating the restricted and prohibited materials list. Before purchasing or using a material, check the most current list at <http://sd.jsc.nasa.gov/omoh/scripts/OccupationalHealth/MSDS.aspx>

#### 15. Waivers to use a restricted or prohibited material

You may request a temporary waiver if the use of a specific restricted or prohibited material is required to achieve JSC’s mission. You shall submit your waiver request in writing to the JE/Environmental Office. The Environmental Office will coordinate review of the waiver request, as appropriate, with the Clinical Services Branch or the Safety and Test Operations Division. The following requirements apply:

- a. Your temporary waiver request shall include the following information:
  - 1. Name and phone number of requestor.
  - 2. Organization name and mail code if NASA ~~(or onsite contractor)~~.

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## Part 9, Safety and health practices for hazardous materials

3. Contract name and number if contractor.
  4. Name and ~~cost accounting standard~~ Chemical Abstract Service (CAS) number of chemical.
  5. Location(s) of proposed use (building and room number).
  6. Description of proposed process using chemical.
  7. Estimated quantity of the chemical that you expect to store and use per year for each location.
  8. Justification for use of the restricted or prohibited chemical. If no alternative is available for the chemical, you shall provide documentation of your efforts to locate an alternative.
  9. If a specification, standard, or contract line item requires the use of this specific chemical; you shall provide a reference to that requirement (contract name and number and contract line item or procedure name and number) and a copy of the requirement.
  10. A copy of the hazard analysis and trade studies (if applicable) for the proposed activity or process that will use the chemical. Include any assessments of alternative materials.
- b. The Environmental Office and the Clinical Services Branch shall approve and sign your temporary waiver before you may use the restricted or prohibited chemical. If a new chemical is placed on the restricted and prohibited chemical list, you have 6 months in which to re-evaluate the process and find an alternative or request a temporary waiver.
- c. Temporary waivers stay in effect for a designated time period of between 1 and 5 years, depending on the safety, health, and environmental characteristics of the chemical. You shall apply for a new waiver and have it approved before the expiration date of an existing waiver to continue using the chemical.

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## 16. Other material restrictions

The following materials, in concentrations specified in the standards listed below, are subject to certain restrictions under 40 CFR 61, "National Emission Standards for Hazardous Air Pollutants" (NESHAP) or under OSHA substance-specific standards. These materials shall follow:

- a. NESHAP restrictions found in this table.

<i>For . . .</i>	<i>Follow this subpart of 40 CFR 61 . . .</i>
Asbestos	M
Beryllium	C
Mercury	E
Vinyl chloride	F

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Radionuclides	I
Benzene	J, Y, BB, and FF

**Part 9, Safety and health practices for hazardous materials**

- b. OSHA restrictions in 29 CFR 1910, “Occupational Safety and Health Standards, General Industry:”

<i><b>For . . .</b></i>	<i><b>Follow 29 CFR 1910 . . .</b></i>
Asbestos	1001
4-nitrobiphenyl	1003
Alpha-naphthylamine	1003
Methyl chloromethyl ether	1003
3,3-dichlorobenzidine and salts	1003
Bis-chloromethyl ether	1003
Beta-naphthylamine	1003
Benzedrine	1003
4-aminodiphenyl	1003
Ethyleneimine	1003
Beta-propiolactone	1003
2-acetylaminofluorene	1003
4-dimethylaminoazobenzene	1003
N-nitrosodimethylamine	1003
Vinyl chloride	1017
Inorganic arsenic	1018
Lead	1025
Cadmium	1027
Benzene	1028
1,2-dibromo-3-chloropropane	1044
Acrylonitrile	1045
Ethylene oxide	1047
Formaldehyde	1048
Methylenedianiline	1050
1,3 Butadiene	1051
Methylene Chloride	1052

- c. OSHA restrictions in 29 CFR 1926, “Occupational Safety and Health Standards, Construction Industry:”

<i><b>For . . .</b></i>	<i><b>Follow 29 CFR 1926 . . .</b></i>
Asbestos	1101
Cadmium	1127
Lead	62
Methylenedianiline	60



## *Transporting hazardous materials*

### **17. Requesting transportation of hazardous materials**

You shall use the following procedure for requesting transportation of hazardous materials:

- a. Contact Transportation Work Control at (281) 483-6563 as much in advance as possible. Transportation resources are limited, and different kinds of hazardous materials cannot be transported together. Schedule transportation of compressed gas cylinders in advance since they are transported on a cylinder truck.
- b. Identify the hazardous material, the amount, the weight, the type of container, and locations for transport. Have an MSDS for the material available at the time of pickup.
- c. The dispatcher will prepare a work order and the pickup will be scheduled, usually within 3 days. Depending on workload and the availability of equipment, work stoppage and rush shipments may be accommodated. Small amounts of certain hazardous materials may be moved by the Quick Dispatch Service within a few hours.
- d. Handle gas cylinders as described in JPR 1710.13, "Design, Inspection, and Certification of Pressure Vessels and Pressurized Systems."

### **18. Transporting hazardous materials**

You shall follow these requirements:

- a. Follow paragraph 3.7.5 of NPR 8715.3, "NASA General Safety Program Requirements."
- b. Never transport hazardous materials on site in your car, truck, any other privately owned vehicle, or NASA administrative aircraft. This includes hazardous materials for personal use with the exception of household concentrations in quantities of less than 5 gallons. You may be denied access to site if you try to transport hazardous materials outside of the above exception.
- c. You may transport only materials that are unopened and packaged in the original DOT-approved shipping containers and only in government or official company vehicles. You shall not travel public roads.
- d. Route all other hazardous materials through the JSC Transportation Branch for appropriate handling per 49 CFR, Subchapter C, "Hazardous Materials Regulations."
- e. Route any hazardous materials leaving JSC, Ellington Field, or Sonny Carter Training Facility that will travel on public roads through the Transportation Branch for appropriate handling per 49 CFR, Subchapter C, "Hazardous Materials Regulations." This includes any materials transported between JSC ("in the fence"), Sonny Carter Training Facility, and Ellington Field.
- f. The Center Operations support services contractor is the only organization authorized to transport hazardous waste.

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- g. The JSC Radiation Safety Officer or his/her designee is the only person authorized to transport radioactive materials.
- h. Craftspeople may transport hazardous materials that are specific to their craft and are essential to their work in a government or official company vehicle designed for that task; they shall not travel on public roads. Examples include welders who transport compressed gas cylinders, custodial workers who transport cleaning fluids, and pesticide applicators who transport pesticides to application sites
- i. Individuals may deliver chemicals for analytical purposes in a government or an official company vehicle only and shall not travel public roads.

### 19. Reporting an accident while transporting hazardous materials

In general, contracted commercial carriers are responsible by law for reporting all accidents involving transportation of hazardous materials. If you are transporting hazardous materials using JSC equipment and have an accident in the public domain, you shall report the accident by:

- a. Calling the DOT Accident Hotline (800-424-8802) if it involves any of the following:
  - 1. A fatality
  - 2. A person requiring hospitalization as a result of injuries received
  - 3. Estimated property damage exceeding \$50,000
  - 4. Possible existence of radioactive contamination
  - 5. A continuous danger existing at the site, such as a spill or leakage of hazardous material
- b. Notifying the JSC Safety and Test Operations Division at (281) 483-4900 and the JSC Transportation Branch at (281) 483-2301. They will help you meet other requirements.  
At WSTF, you shall notify the NASA Safety Officer (Quality Assurance, Reliability, and Safety Office) and the Chief, Engineering Office. The WSTF Safety Officer will notify the JSC Director, Safety and Mission Assurance, for you.
- c. Follow Chapter 2.7, "Mishap and incident investigation," of this handbook for further guidance on mishap reporting and investigation.

The Director, Safety and Mission Assurance, shall notify the NASA Headquarters Safety and Risk Management Division of the accident and will make sure that the DOT has been notified. This includes sending a written follow-up report to the Associate Director for Hazardous Materials Regulations, DOT, Washington, D.C. 20590, within 15 days as stated in 49 CFR 171.16, "Detailed Hazardous Materials Incident Reports." It also includes sending copies to the NASA Safety Division, Office of the Chief Engineer, NASA Headquarters.

## *Emergency reporting and response*

### **20. Reporting emergencies**

You shall report all emergencies at JSC and Ellington Field by calling your emergency number; x33333 for JSC and the Sonny Carter Training Facility, x44444 for Ellington Field, 911 off site, and x5911 at WSTF.

### **21. Emergency response**

Spills or leaks of hazardous materials often will require containment and countermeasures under EPA and OSHA regulations. Usually when a hazardous material spills or leaks into the environment or becomes an immediate threat to the safety of personnel or facilities, an emergency exists and requires immediate response under established contingency plans. Handle all leaks and spills as described in JPR 8550.1, “JSC Environmental Compliance Procedural Requirements,” mishap reporting requirements in this handbook (see Chapter 2.7), and JSC’s emergency response plan. The Occupational Health Department will acquire specific information on trade name products for purposes of emergency or first-aid treatment

## *Other requirements and responsibilities*

### **22. For more information on handling hazardous materials**

- a. 29 CFR 1910, “Occupational Safety and Health Standards, General Industry”
- b. 29 CFR 1926, “Occupational Safety and Health Standards, Construction Industry”
- c. Clean Air Act of 1990, 42 U.S.C. Section 7401, et seq.
- d. 49 CFR Parts 171–174, “Hazardous Materials Regulations” (DOT)
- e. *Department of Transportation Emergency Response Guidebook* (latest edition)
- f. 40 CFR 61, “National Emission Standards for Hazardous Air Pollutants” (EPA)
- g. 40 CFR Parts 240–281, “Solid and Hazardous Waste Regulations” (EPA)
- h. 40 CFR Parts 370–372, “Emergency Planning and Community Right-to-Know” (EPA)
- i. 40 CFR 355, “Emergency Planning and Notification”
- j. 40 CFR 302.4, “Designation of Hazardous Substances”
- k. NPR 8715.3, “NASA General Safety Program Requirements”
- l. NPD 1820.1, “NASA Environmental Health Program”
- m. NPD 8800.16, “NASA Environmental Management”
- n. JPR 8550.1, “Environmental Compliance Procedural Requirements”

## Part 9, Safety and health practices for hazardous materials

- o. National Fire Protection Association Class IA flammable liquids

### 23. Additional responsibilities for hazardous materials

The following have responsibilities for hazardous materials:

- a. As a **supervisor** you are responsible for:
  - 1. Making sure that a quarterly hazardous material inventory is completed and providing inventory information to the Clinical Services Branch in the format specified. (See Chapter 9.2 of this handbook.) Making additions and deletions to your hazardous material inventory as they occur will make it easier to keep current.
  - 2. Providing PPE to control the hazards of the materials being handled. The Clinical Services Branch will help you select PPE.
  - 3. Following all requirements for restricted and prohibited materials.
  - 4. Developing and maintaining a hazard analysis for your processes that use hazardous materials as described in Chapter 2.4, "Hazard Analysis," of this handbook and in JSC 17773.
- a. Making sure that hazardous materials in your control have adequate evacuation and response procedures for a release or spill. You shall coordinate your procedures with your facility manager to ensure a unified emergency action plan for the facility.
- b. As a **facility manager**, you are responsible for making sure that emergency action procedures you develop for your facility consider inputs from any supervisors in your facility who control hazardous materials, which, if released, could result in evacuation of your facility.
- c. As the **person (civil service or contractor) who is responsible for managing operations** and who has stated decision-making authority and control over operations and activities involving hazardous materials, you are responsible for:
  - 1. Making the following certification at least once per calendar year: "I certify that I have personally examined and am familiar with this list or inventory and that based on my inquiry of those individuals immediately responsible for obtaining the information, it accurately reflects the materials used and stored within the defined work area under my authority. I also certify that each of these hazardous materials is necessary for the successful performance of activities within my area of responsibility; that no prohibited materials are on the list unless approval to use them has been granted in writing by the JSC Hazardous Materials Working Group; and that periodic evaluations are conducted and documented in order to ensure that less hazardous materials have been substituted whenever possible to do so."
  - 2. Signing the certification and attaching it to the hazardous materials list or inventory. You may need to make inquiries of more than one person to validate the accuracy and sign the certification. JSC's safety, health, and environmental staff will periodically

## **Chapter 9.1, Hazardous materials safety and health**

audit certification and backup documentation to ensure that the lists are accurate and that evaluations for prohibited materials and substitutions have occurred.



# Chapter 9.5

## Explosives and solid propellant safety

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### ***This could be you . . .***

*An employee received minor injuries when a NASA standard initiator ignited from being exposed to RF radiation without a Faraday cap installed.*

*A small amount of propellant ignited when someone scraped it with a “non-sparking tool.” No one was hurt, but the employee was very surprised.*

*A propellant production facility was heavily damaged when spilled propellant ignited. The cost of this accident was in excess of \$10 million.*

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### **1. Applicability of this chapter**

You are required to follow this chapter if you use, test, handle, store, receive, transport, or dispose of explosives, solid propellants, or systems containing explosives or solid propellants.

### **2. Definition of an explosive, solid-propellant system that contains an explosive or solid propellant, or of an electro-explosive device**

The following defines an explosive, solid propellant, system that contains an explosive or solid propellant, or electro-explosive device (EED):

- a. An explosive is a material that undergoes rapid chemical change and generates large amounts of hot, high-pressure gases when exposed to heat, impact, friction, detonation, or other means of ignition.
- b. A solid propellant is an explosive mixture that propels rockets or missiles, or generates gases for powering auxiliary devices or systems. Solid propellant and propellant, as used in this chapter, mean the same thing.
- c. A system that contains explosives, propellants in any system, subsystem, component, or device that functions by igniting an explosive or a propellant inside the system, subsystem, or component. “System” is used instead of “system that contains explosive, or propellant” in this chapter.
- d. An EED is a system that contains explosives or propellants, and that is fired by passing an electrical current through the explosive or propellant.

### **3. Precautions when working with explosives, propellant, or systems**

You shall follow the requirements below when working with explosives, propellants, or systems at JSC:

## **Part 9, Safety and health practices for hazardous materials**

- a. Follow NASA Safety Standard 1740.12, “Explosives Safety.”
- b. Don’t handle explosives, propellants, or systems in a manner that could cause damage.
- c. Don’t carry explosives, propellants, or systems in pockets, toolboxes, lunch boxes, or other unprotected places.
- d. Don’t expose explosives, propellants, or systems to open flame, direct sunlight for long periods of time, or heating and electrical equipment.
- e. Don’t use bale hooks to handle explosives, propellants, or systems.
- f. Don’t use nails through packing materials or containers of explosives, propellants, or systems.
- g. Keep the safe distances required by paragraph 6.d.
- h. Have a Hazardous Operations Permit as described in Chapter 5.8, “Hazardous operations: safety practices and certification,” of this handbook.

### **4. Special precautions when working with explosives, propellants, or systems**

You shall do the following:

- a. Prepare detailed operating procedures listing tasks in a logical order that doesn’t introduce new hazards.
- b. Prepare a hazard analysis before you work with explosives, propellants, or systems.
- c. Have a Safety and Test Operations Division representative review and sign off on the detailed test procedures and hazard analysis.
- d. Prohibit smoking, open flames, or heat-producing operations around explosive or propellant systems.
- e. Make sure that test chambers are designed and built to JPR 1710.13, “Design, Inspection, and Certification of Pressure Vessels and Pressurized Systems.”
- f. Allow only authorized personnel, trained in accordance with paragraph 9, to handle explosives, propellants, or systems.

### **5. Working safely with EEDs**

You shall:

- a. Follow all other requirements for working with explosives, propellants, or systems in this chapter.
- b. Twist wire leads together or shield them and attach the leads to a good ground.
- c. Make sure that wire leads are not twisted into loops, dipole antennas, or other types of antennas.



## Chapter 9.5, Explosives and solid propellant safety

- d. Provide electromagnetic protection with Faraday plugs or caps on EEDs with connectors instead of wire leads. If they are not available, use other means of protection, such as shorting springs or aluminum foil between the connectors.
- e. Eliminate electrostatic charge buildup by using wriststats or legstats.
- f. Never use or allow radios, cellular telephones, or other transmitting equipment around EEDs.
- g. Never rub or polish EEDs.
- h. Use only continuity testers and firing units specifically designed for use with EEDs.

### 6. Safely store explosives, propellants, or systems

There are several things that you shall do when storing explosives, propellants, or systems:

- a. You shall follow these requirements in and around storage locations:
  - 1. Remove all loose packing materials, skids, dunnage, empty boxes, and other combustible materials from magazines.
  - 2. Mow and clean a 50-foot or larger fire break around your magazine.
  - 3. Don't use or store flammable materials in magazines.
  - 4. Don't allow flame-, spark-, or other-producing devices in magazines without written permission from the Safety and Test Operations Division.
  - 5. Don't smoke within 50 feet of a magazine.
  - 6. Don't use magnesium flashlights, X-ray equipment, photographic flashbulbs, or strobe lights with 10 feet of a magazine without written permission from the Safety and Test Operations Division.
  - 7. Use only "non-sparking" or reduced-sparking tools around explosives, propellants, or systems.
- b. You shall follow these requirements for all facilities storing explosives:
  - 1. Have the Safety and Test Operations Division review and approve all facilities used to store explosives, propellants, or systems.
  - 2. Keep magazine doors in good working condition.
  - 3. Keep magazine doors locked at all times, except when working in the magazine.
  - 4. Have at least one 3A- or larger-rated fire extinguisher in good working condition, outside the magazine.
  - 5. Separate storage according to the class, division, and storage compatibility group (SCG). See paragraphs 6 and 7 of this chapter.
  - 6. Post signs stating, "Explosives," "No Smoking," along with the appropriate fire symbol. See paragraph 10 of this chapter.

## Part 9, Safety and health practices for hazardous materials

7. Keep up-to-date inventories of all explosives, propellants, and systems stored in the magazine.
- c. You shall follow these requirements to avoid problems with electrical energy:
  1. Meet the National Fire Protection Association Standard 70, “National Electric Code,” for hazardous locations.
  2. Provide static grounding systems per N~~ASA-STD-187~~1940.12, “Explosives Safety,” Chapter 5.
  3. Provide lightning protection per N~~ASA-STD-187~~1940.12, Chapter 5.
  4. Check all grounding systems at least every 6 months.
- d. You shall observe the following safe distances:

<i>If the class and division is . . .</i>	<i>And if the exposure is to . . .</i>	<i>Use the safe distance tables listed in . . .</i>
1.1	Inhabited buildings or public transportation routes	N <del>ASA-STD-187</del> 1940.12, Table <del>XIII</del> 8-1
1.1	Operations on the same line	N <del>ASA-STD-187</del> 1940.12, Table <del>XIII</del> 8-2
1.1	Other magazines	DOD 6055.9-STD, “Ammunition and Explosives Safety Standard,” Tables 9-4 and 9-5
1.2	Anything	DOD 6055.9-STD, Tables 9-6 to 9-9
1.3	Anything	N <del>ASA-STD-187</del> 1940.12, Table <del>XXIII</del> 8-3
1.4	Any exposure	DOD 6055.9-STD, Table 9-11
1.5	Same as 1.1	
1.6	Same as 1.1	

### 7. What the class and division numbers and SCGs mean

The class and division numbers and the SCGs were set up by the United Nations Organization for storage and shipment of hazardous materials worldwide. Explosives, propellants, and systems fall under Class 1. The divisions and SCGs indicate the relative hazard within Class 1:

- a. Use the following table to find the class and division:

<i>If the hazard from the explosive, propellant, or system is . . .</i>	<i>The class and division is . . .</i>
Mass detonation of almost all the material	1.1
Fragments or firebrands	1.2

## Chapter 9.5, Explosives and solid propellant safety

<i>If the hazard from the explosive, propellant, or system is . . .</i>	<i>The class and division is . . .</i>
Mass burning of almost all the material, but not detonation	1.3
Minor fire or blast damage limited to the package	1.4
Mass detonation of the material, but there is very little chance of detonation or mass burning causing detonation	1.5
Mass detonation of the system, but very little chance of accidentally initiating the system	1.6

- b. Use this table to find the SCGs:

<i>If the explosive, propellant, or system is . . .</i>	<i>The SCG is . . .</i>
An initiating explosive that is sensitive to heat, friction, or percussion	A
A detonator or other device that contains explosives designed to initiate an explosives train	B
A bulk propellant, propelling charge, or system with or without its own way of initiating	C
A bulk explosive or system that contains explosive with its own means of ignition and two or more independent safety features	D
A system that contains explosives and propelling charges, without its own means of ignition; doesn't include systems that contain flammable or hypergolic liquids	E
A system that contains explosives and propelling charges with its own means of ignition; doesn't include systems that contain flammable or hypergolic liquids	F
Fireworks, an illuminating, incendiary, smoke-, tear-, or noise-producing system; doesn't include water activated or white phosphorus	G
A system that contains explosives and white phosphorus or pyrophoric materials	H
A system that contains explosive and flammable liquids or gels	J
A system that contains explosives and toxic chemical agents	K
A system or bulk explosive or propellant not in other SCGs; not having characteristics allowing storage with other types of systems; waste, damaged, or contaminated explosives, propellants, or systems; or a new explosive, propellant, or system	L
A system that is extremely insensitive	N
A system that presents minor blast or fire hazard that is designed to confine the effects within the system or the packaging and doesn't hamper firefighting activities around the system	S

## **Part 9, Safety and health practices for hazardous materials**

### **8. Protective clothing and equipment to use when working with explosives, propellants, or systems**

When you work with explosives, propellants, or systems, you shall first perform a hazard analysis to determine what PPE is required. It may include the following types of PPE:

- a. Eye protection
- b. Face shields
- c. Wriststats or legstats
- d. Conductive safety shoes
- e. Non-static-producing clothing such as cotton or specially treated anti-static garments

### **9. Training to work with explosives, propellants, or systems**

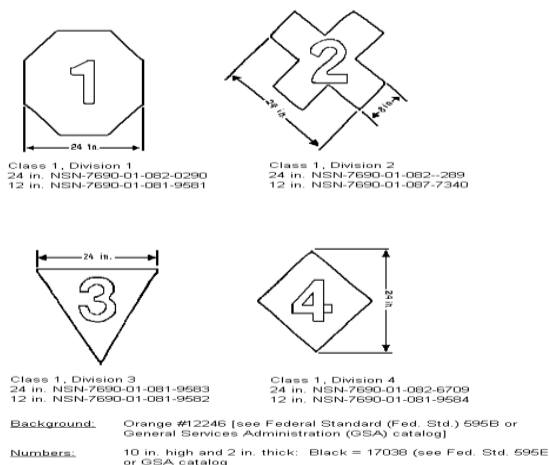
You need to be certified to handle explosives, propellants, or systems under Chapter 5.8, “Hazardous operations: safe practices and certification,” of this handbook. Your training shall cover the following subjects for each explosive, propellant, or system that you work with:

- a. Nature and properties of the explosive, propellant, or system
- b. Correct PPE to use in specific environments and where you can find it
- c. Approved materials that are compatible with the explosive, propellant, or system
- d. Proper handling methods for the explosive, propellant, or system
- e. Proper storage for the explosive, propellant, or system
- f. Proper transportation requirements for the explosive, propellant, or system

### **10. Fire symbols for working with explosives, propellants, or systems**

Post the following fire symbols as described in the tables below.

## Chapter 9.5, Explosives and solid propellant safety



Post fire symbols in the following ways:

<i>If the explosive, propellant, or system hazard is . . .</i>	<i>The fire symbol is . . .</i>
Mass detonating	1
Fragment or blast damage	2
Mass fire	3
Moderate fire, minor explosive	4

Post fire symbols in the following ways:

<i>On . . .</i>	<i>Then display . . .</i>
Small buildings	A symbol on each side of a building
Buildings with long sides	As many symbols as required, but more than one
Buildings that are not visible from approaches	At least one symbol on each approach
Storage buildings	At least one symbol on a building
Vehicles transporting explosives on site at JSC	At least two symbols on the vehicle

### 11. Emergency actions for explosives, propellants, or systems

You shall take the following actions for these emergencies:

- If an *explosion* happens, you shall:
  - Evacuate the building according to your building's EAP.
  - Call your emergency number and report the explosion.

## Part 9, Safety and health practices for hazardous materials

- b. If a **fire** happens, you shall call you emergency number and take action as described in this table for the fire symbol posted.

<i>If the fire symbol is . . .</i>	<i>Then . . .</i>
1	<ul style="list-style-type: none"><li>• Don't fight the fire unless you have planned a rescue attempt</li><li>• Don't try to put out the fire unless other fire symbol 1 materials are far enough away and the fire chief approves</li><li>• Take cover if your safety is in doubt</li></ul>
2	<ul style="list-style-type: none"><li>• Sound an alarm</li><li>• Fight the fire only if it is in the beginning stages and you are trained to do so</li><li>• Prevent the fire from spreading, if possible</li><li>• Protect yourself from fragments</li></ul>
3	<ul style="list-style-type: none"><li>• Fight the fire only if explosives are not involved and you are trained to do so</li><li>• Use lots of water if white phosphorus or tear-producing agents are involved</li><li>• Use dry sand or dry powder in the early stages of a fire involving tear-producing agents</li><li>• Don't use CO<sub>2</sub>, water, or halon on fires involving magnesium, titanium, aluminum, or other light metals; use a 2-inch layer of dry sand or powder on the floor for light metal fires; rake the burning metals into the layer of sand or powder and put another layer of sand or powder on top of the burning metals</li></ul>
4	<ul style="list-style-type: none"><li>• Fight these fires</li><li>• Protect yourself from minor explosions and hot fragments</li></ul>

Remember, your emergency numbers are: x33333 at JSC or Sonny Carter Training Facility, x44444 at Ellington Field, 911 at any off-site location, and x5911 at WSTF. You shall call your emergency number if you see an emergency.

## 12. For more information on working with explosives, propellants, and systems

You can find more information on working with explosives, propellants, and systems in these documents:

- Department of Defense, DOD 6055.9-STD
- Air Force Manual, AFM 91-201, "Explosives Safety Standard"
- Army Materials Command Regulation, AMC-R 385-100, "Safety Manual"
- Army Technical Manual, TM5-1300, "Structures to Resist Accidental Explosions"
- ~~ASA-STD-1871940~~.12, "Explosives Safety."
- JPR 1710.13, "Design, Inspection, and Certification of Pressure Vessels and Pressurized Systems"

## Chapter 9.5, Explosives and solid propellant safety

- g. 49 CFR 172–183, “Department of Transportation Regulations for Transportation of Hazardous Materials”

### 13. Responsibilities for explosive Safety:

The following individuals and organizations have responsibilities for explosive safety:

- a. The ***JSC Authority Having Jurisdiction for Explosives Safety*** is responsible for maintaining a current master list of explosive storage sites and their locations, fire symbols, chemical storage sites, and available empty storage sites. This list shall be available to emergency forces (e.g., fire department, guard forces) at all times.
- b. The ***Safety and Test Operations Division*** is responsible for keeping a current copy of the master list of storage sites to make available to emergency forces (e.g., fire department, guard forces) as needed.
- c. The ***Security Office*** is responsible for keeping a current copy of the master list of storage sites to make available to emergency forces (e.g., fire department, guard forces) as needed.





# Chapter 10.3

## Facility Readiness Reviews for Hazardous or Critical Facilities

### 1. Applicability of this chapter

You are required to follow this chapter if you:

- a. Oversee a facility described in paragraph 3 of this chapter.
- b. Are a member of an ORI or a URR committee.
- c. Are a director with a facility that requires a facility readiness or URR.

### 2. Definition of a facility readiness review

A facility readiness review is a review to determine whether a facility is ready to operate and operate safely after initial construction or modification. There are two levels of facility readiness reviews at JSC, depending on the hazards, criticality, or complexity of the facility, which are listed and defined below:

- a. An ORI is a rigorous formal inspection by a committee to approve a facility as ready to operate safely and effectively before it begins operations.
- b. A URR is a less rigorous and less formal review to approve less hazardous, complex, or critical facilities as ready to operate safely and effectively before they begin operations.

**Note:** Other requirements in this handbook, such as Chapter 6.9, require readiness reviews for specific activities, such as hazardous testing. Chapter 10.3 only covers reviews necessary to approve initial facility operation or resuming facility operation after a modification.

### 3. Requirements for facility readiness reviews

“Facility,” as used in this chapter, may be a building, a work area in a building such as a test chamber, or an outside work area. Facilities with a small risk of injury, damage, or mission failure, such as office buildings, don’t require a facility readiness review, but other standards may require acceptance testing of certain systems (see Chapter 10.1 of this handbook). The table provides the criteria for which facilities shall have an ORI or a URR. An ORI or URR shall cover the facility, associated facility systems, and associated facility equipment. Test equipment will normally be reviewed and approved by the TRR process. In unique situations, test equipment may require a URR or ORI as designated by the Director, Safety and Mission Assurance or their designee. Equipment which falls outside the definition of test equipment is considered facility test support equipment and is covered under the URR or ORI process.

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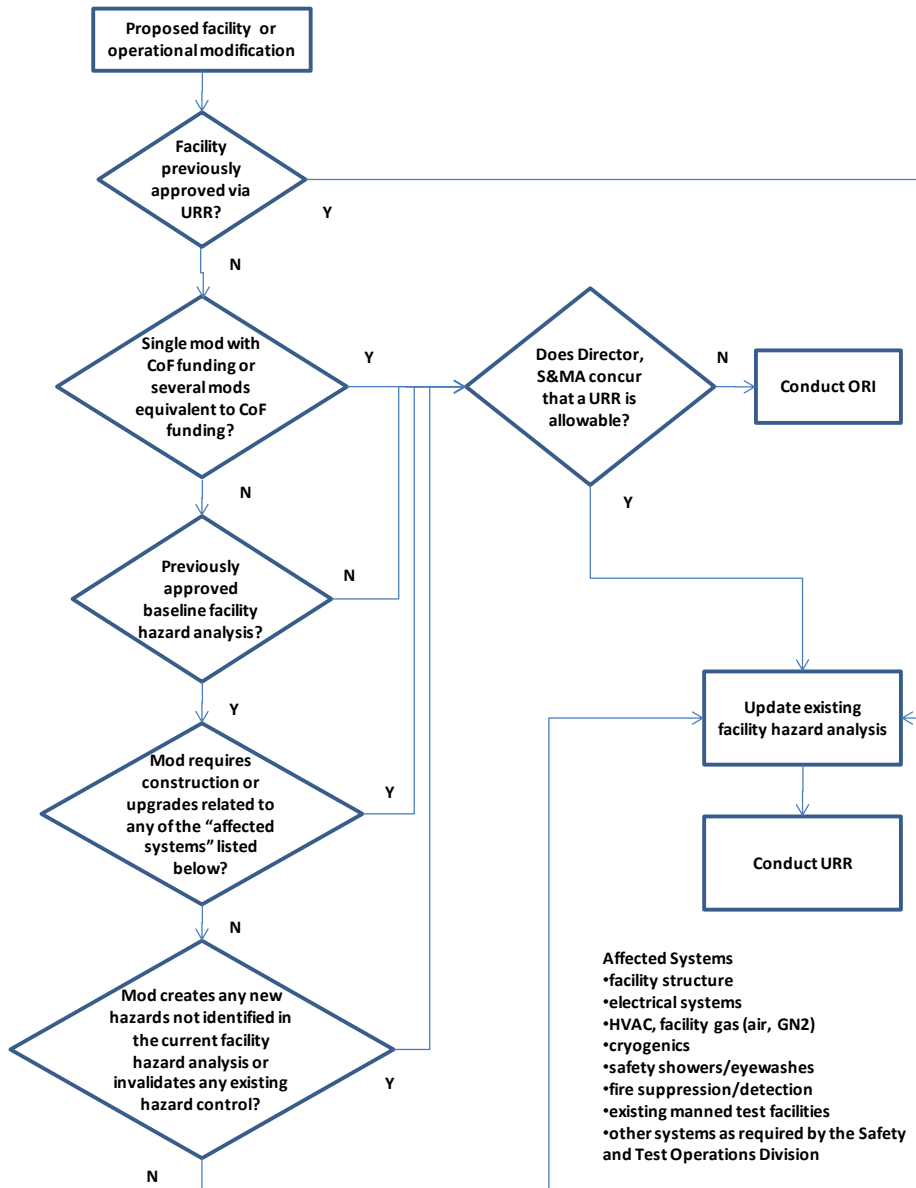
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**Part 10, Safety and health requirements for facilities and facility systems**

<i><b>Facility . . .</b></i>	<i><b>ORI criteria . . .</b></i>	<i><b>URR criteria . . .</b></i>
New JSC Facilities	Major facilities that pose a significant risk of death, serious injury, serious property damage, failure of JSC's mission, or failure of space flight missions.	Facilities that pose a very low risk of death, serious injury, or mission failure.  Facilities that pose a significant risk of minor injury, moderate property damage, or mission failure.  The Director, Safety and Mission Assurance <u>or designee</u> , shall concur that a URR, rather than an ORI, is allowable.
Modifications to JSC Facilities <u>that were previously approved via an ORI or URR.</u>	<del>See Flowchart below. Generally modifications done with Construction of Facilities funding or several minor modifications to facilities that would require an original ORI.  Major modifications to critical or hazardous systems, regardless of dollar value, or changes in management philosophy or operation within hazardous or critical facilities.  The facility management may conduct a URR if the Director, Safety and Mission Assurance, concurs.</del>	<del>See Flowchart below. Generally modifications done with less than C of F funding that pose a low risk to personnel, property, or mission  The JSC Director, Safety and Mission Assurance, shall concur that a URR, rather than an ORI, is allowable.</del>
Non-JSC Facilities where JSC personnel participate in hazardous operations	Non-JSC facilities with personnel in a vacuum or an oxygen-enriched environment with a contract or agreement with any non-JSC organization to support a JSC program that includes this chapter. This chapter applies to non-JSC facilities that: <ul style="list-style-type: none"> <li>• Have altitude, space simulation, or hyperbaric chambers</li> <li>• Test or check out spacecraft</li> <li>• Use other equipment in operations with personnel in a vacuum or an oxygen-enriched environment</li> </ul>	Non-JSC facilities where other hazardous environments are involved at the discretion of Safety and Mission Assurance management or the managers overseeing personnel working at the facility.

### Chapter 10.3, Facility Readiness Reviews for Hazardous or Critical Facilities



Criteria for ORI and URR for facility modifications.

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## **Part 10, Safety and health requirements for facilities and facility systems**

### **4. When a facility readiness review is done**

When required by paragraph 3 above, a facility shall have a facility readiness review before starting or resuming operations. The following apply:

- a. The organizational director responsible for the facility shall ensure that the facility readiness review is held before acceptance testing, but may conduct non-hazardous tests and check out the facility's systems and equipment before the facility readiness review unless the facility uses human subjects in a vacuum or an oxygen-enriched environment.
- b. You shall never put personnel in a hazardous environment or jeopardize NASA property or missions as a part of any test or checkout before:
  1. Completing at least an initial facility readiness review and resolving the committee's recommendations.
  2. Following human research policies and procedures such as NPD 7100.8, "Protection of Human Research Subjects."

### **5. Appointing a review committee**

The following outlines the process for appointing an ORI or a URR:

- a. For an ORI:
  1. The organizational director responsible for the facility coordinates with the center director and Safety and Mission Assurance to select the ORI chair. They may also suggest potential members for the ORI committee.
  2. The center director appoints the chairperson of the committee via a letter.
  3. The ORI chair selects the committee members, considering any suggestions made.
- b. For a URR:
  1. The division chief responsible for the facility nominates members for the URR committee and prepares an appointing letter for the signature of the responsible organizational director.
  2. The organizational director is the appointing authority and will appoint a committee chairperson.

### **6. Committee membership**

A review committee normally has a chairperson, an executive secretary, and around six more voting members. The membership listed below is mandatory for ORIs. For URRs, Safety, Occupational Health, and Medical may waive their participation. A review committee shall have the following members and supporting personnel:

### Chapter 10.3, Facility Readiness Reviews for Hazardous or Critical Facilities

- a. The following rules apply to ORIs and may be considered by the appointing authority for URRs. The center director may make exceptions to these rules to include highly qualified specialists as committee members:
  - 1. All committee members who are division chiefs or below shall come from an organization other than the one responsible for the facility. Personnel in the facility organization support the ORI committee.
  - 2. At least two members shall be division chief level or above.
  - 3. Other members shall be branch chief level or above.
- b. The committee chairperson who runs the committee shall be a division chief or above.
- c. The executive secretary who does administrative tasks for the committee and:
  - 1. Advises the organization responsible for the facility as it prepares for the facility readiness review.
  - 2. Develops a review schedule and agenda after consulting with the organization responsible for the facility.
  - 3. Presents the schedule and agenda for approval at the first committee meeting.
  - 4. Attends meetings held to prepare for the facility readiness review to provide direction, answer questions about the committee's requirements for the inspection, and assist in preparing variance requests, if required.
- d. If required, a doctor knowledgeable of occupational and environmental medicine requirements.
- e. An industrial hygienist if occupational health concerns are involved.
- f. One representative from the Safety and Test Operations Division or resident quality assurance, reliability, and safety office.
- g. One representative from the quality branch. At JSC field sites, one person from the resident Quality Assurance, Reliability, and Safety Office may represent safety and quality.
- h. One representative from the organization that supplies the test subjects.
- i. Other members from disciplines such as facility engineering, facility management techniques, and test engineering. Members from non-JSC organizations are also desirable.
- j. Alternate members picked by the appointing authority to fill in for regular members who must be absent because of emergencies.
- k. Personnel who support the facility readiness review to include:
  - 1. The management, responsible for the facility, who will serve as the single point of contact with the review committee and make sure the facility is ready for the review.

## Part 10, Safety and health requirements for facilities and facility systems

2. Personnel who operate the facility or those asked to support the review. These personnel shall cooperate with the review committee by providing information requested during the review.

### 7. Facility readiness review process

A facility readiness review usually follows this process. The chairperson may change the procedure to fit the circumstances as long as the intent of the procedure is fulfilled. The steps are:

- a. The committee meets when called together by the chairperson. The committee shall keep records of its proceedings. The review begins with:
  1. A committee briefing from those who designed or will operate the facility. This briefing shall summarize the information needed in paragraph 8 of this chapter.
  2. The committee tours the facility.
- b. The committee decides what other information and details are needed.
- c. The chairperson assigns teams of one to three members who investigate and gather the information and details needed and then report back to the full committee. Any committee member may investigate any item personally if he or she wants to.
- d. Committee members note discrepancies and recommendations and turn them in to the secretary, who assigns a control number.
- e. The full committee evaluates and classifies all recommendations. For ORIs, see paragraph 9 of this chapter. URR committees assign action items to the facility through committee consensus. Members with minority opinions may appeal to the appointing authority or the Safety and Mission Assurance Director.
- f. The committee reviews its recommendations or action items with facility personnel to make sure that the recommendations are understood and that the committee has not acted on the basis of inaccurate or incomplete information. The management responsible for the facility makes sure corrective actions are done.
- g. The committee issues its findings and recommendations in writing to the appointing official or others as necessary.
- h. The committee follows up to make sure the facility takes action on mandatory recommendations by the deadlines.
- i. The committee issues a final report and sends copies to the appointing authority and the manager responsible for the facility.
- j. The committee continues to act until the facility is approved for operations. This may involve overseeing or reviewing the results of acceptance testing.

### Chapter 10.3, Facility Readiness Reviews for Hazardous or Critical Facilities

- k. The appointing authority, after accepting the final report, disbands the committee unless he or she decides that the committee will do post-facility readiness review as described in paragraph 12 of this chapter.
- l. The committee shall ensure that any discrepancy that constitutes any safety hazard that will not be permanently abated by the time the facility is declared ready for operations is entered in the JSC Hazard Abatement Tracking System (HATS). Interim and final abatement plans will also be developed, implemented, and documented in HATS. See Chapter 3.5, “Hazard Correction Tracking”, for details.

#### 8. Committee activities

The review committee shall make sure the following are adequate for safety, health, and operations:

- a. Facility design, construction, or changes.
- b. Facility staff to include:
  - 1. Its size and organization.
  - 2. The responsibilities of each staff member.
  - 3. Training for each staff member.
- c. Interfaces among and responsibilities for all organizations that operate or use the facility.
- d. Pre-operations inspection, quality control, and shakedown testing in the facility.
- e. Plans and procedures for normal and emergency operations.
- f. Facility baseline documentation described in Chapter 10.4, “Facility Baseline Documentation Requirements for Critical, Complex, or Hazardous Facilities,” of this handbook
- g. Facility safety program to include the following:
  - 1. Supporting safety services and facilities.
  - 2. Hazard analyses.
  - 3. Compliance with all safety requirements that apply to the facility, such as this handbook and other JSC, NASA, National Fire Protection Association, and federal requirements.
  - 4. Human factors and occupational health.
- h. Reliability, failure mode and effects analyses, and single-point failure summaries.
- i. Other factors that directly or indirectly affect the safe operation of the facility.
- j. Environmental protection in JSC facilities.

## Part 10, Safety and health requirements for facilities and facility systems

### 9. Classifying ORI committee recommendations

An ORI committee shall classify each recommendation in one of four categories and set deadlines to have actions on recommendations completed. The classifications are:

<i>Classification . . .</i>	<i>Vote required . . .</i>	<i>Other requirements . . .</i>
Mandatory—involves a credible risk of a mishap or an operational problem that could cause injury, death, major property damage, or a priority impact to the environment	One-third vote of the full committee	Note all votes for “mandatory” in minutes and reports if a recommendation doesn’t get the necessary one-third majority vote
Non-mandatory—involves risk of minor property damage, operational problems, or other impact to the environment where immediate action isn’t required	Any vote that doesn’t classify the recommendation as mandatory, further study needed, or rejected	None
Further study needed	A majority vote of the full committee	Assign action items for further study, track them to completion, and document the results in the final report
Rejected	A majority vote of the full committee	Document all “rejected” recommendations in the final report

### 10. Final report

The final report shall include:

- Recommendations or action items and their corrective actions. JSC form JF602 is available online <http://forms.jsc.nasa.gov/> for use in documenting the committee’s RIDs.
- Any variances from recommendations or requirements.
- Recommendation for certification that the facility is approved for operation.
- A presentation before the JSC Management Council is required before the center director grants certification. The facility manager conducts this presentation in conjunction with the committee chairperson.

### 11. Addressing review committee recommendations and action items

As the manager responsible for the facility, you shall:

- Take corrective action on all mandatory ORI recommendations and URR action items by the committee deadlines.



### Chapter 10.3, Facility Readiness Reviews for Hazardous or Critical Facilities

- b. Never conduct any operations that involve personnel in a hazardous environment before corrective action on mandatory recommendations is complete.
- c. Consider non-mandatory ORI recommendations or any other URR recommendations for early implementation.
- d. Present actions taken to the committee for approval and provide written documentation as necessary.
- e. Discuss any mandatory ORI recommendation or URR action item that you can't take action on because of cost, operational, or schedule impacts with the committee. If the committee doesn't change the recommendation or action item, you shall request a variance. Follow these rules for variances:
  - 1. Request a variance from the center director through the committee for recommendations that don't involve JSC, NASA, National Fire Protection Association, state, or federal requirements.
  - 2. Follow the variance process in Chapter 1.4, "Written Safety And Health Program," of this handbook for variances from JSC, NASA, National Fire Protection Association, state, and federal requirements. Make sure the ORI committee also reviews the variance requests.
  - 3. Have the senior manager from the organization that supplies test subjects concur on any variance request that involves the safety of human subjects.
- f. Keep a copy of the final report as described in Chapter 10.4 of this handbook.

### 12. Post-facility readiness reviews

As the manager responsible for the facility, you are encouraged to bring the review committee or another committee in to review your facility and operation, especially if your facility uses human subjects in a vacuum or an oxygen-rich environment. It is recommended that you hold such a review at least once each 6 months or more often if you think it is necessary due to conditions or special problems in the facility. Make sure written records of any post-facility readiness reviews are sent to the appointing authority.

### 13. Non-JSC facilities

Facility readiness reviews are done on non-JSC facilities as described in paragraph 3 of this chapter. If JSC has a contract or an agreement with your non-JSC organization as described in paragraph 3 of this chapter, you shall:

- a. Send JSC a list of facilities that you believe require a facility readiness review. You shall send this list within 14 days of signing the contract or agreement, or at any later time when you find that a facility readiness review is needed.
- b. The list shall include information to help JSC evaluate your facilities such as:

## Part 10, Safety and health requirements for facilities and facility systems

1. A general description of the facility and its operations
2. What JSC project the facility supports
- c. Follow this chapter with these exceptions:
  1. The person in charge of your site or a higher-level official will be the appointing official. He or she will fulfill the responsibilities of the appointing authority found in this chapter.
  2. Committee members shall be equal in rank to JSC division and branch chiefs as described in paragraph 6 of this chapter. JSC will arrange for committee members from government organizations if necessary.
  3. The same committee members may participate in more than one review. However, you shall keep the review for each facility and its records separate from reviews and records for other facilities.
- d. Allow JSC to send qualified observers if necessary. These observers shall have access to all committee meetings and records.
- e. Send the final report to the Director, Safety and Mission Assurance. He or she shall send the report and his or her personal assessment of the facility's overall safety to the JSC Center Director. The report is to include all information on variances to mandatory ORI recommendations or URR action items and the schedule and due dates for corrective action on all mandatory and non-mandatory ORI recommendations or URR action items.
- f. Send a plan for post-facility readiness reviews recommended in paragraph 12 of this chapter to the JSC Center Director and the Director, Safety and Mission Assurance.

### 14. Maintaining ORI committee reports

The facility manager or lab manager shall keep a copy of the report as a part of the Facility Baseline Documentation (see Chapter 10.4 of this handbook). The Safety and Mission Assurance director sends ORI reports to the NASA Headquarters Safety and Risk Management Division as requested. Resident quality assurance, reliability, and safety offices will keep copies of ORI reports for JSC remote sites.

# Chapter 10.4

## Facility baseline documentation requirements for critical, complex, or hazardous facilities

### 1. Applicability of this chapter

You are required to follow this chapter if you:

- a. Oversee a facility described below or on the ~~listed in appendix 10, attachment 10.4A of facilities requiring Facility Baseline Documentation at the following URL:~~  
[http://www6.jsc.nasa.gov/safety/FacMgr/List of FBD Facilities.pdf](http://www6.jsc.nasa.gov/safety/FacMgr/List_of_FBD_Facilities.pdf).
- b. Are the area director at JSC and have facilities described below or on the ~~listed in appendix 10, attachment 10.4A. Paragraph 12 of this chapter lists your responsibilities at the URL in subparagraph a.~~

### 2. What facilities require facility baseline documentation

“Facility,” as used in this chapter, may be a building, a work area in a building such as a laboratory, or an outside work area. A facility shall have facility baseline documentation if it:

a. Is critical to JSC’s overall mission, such as:-

1. Unique, irreplaceable facilities that support manned space flight activities.
2. Facilities directly supporting those unique, irreplaceable facilities that provide water, electrical, heating, & cooling, and computer services.
- 4-3. Facilities which contain historically significant national treasures including, film, video, and scientific specimens that are irreplaceable.

b. Is hazardous, such as:-

1. Facilities, by their standard operation/mission, subject personnel to risks/hazards that are not normally seen in the standard workplace environment. Such as high voltage/current electricity, plasmas, vacuum environments, hypobaric or hyperbaric test chambers, cryogenics, and manned suited operations.
- 4-2. Facilities which house or utilize materials that are explosive, flammable, toxic, caustic, radioactive, or oxidizers.

c. Has very complex operating systems, such as those that:-

1. Require multiple organizations to conduct operations of the facility or facility mission.
2. Require extensive employee training to operate.
3. Have integrated systems internally and externally using specialty and prototype equipment.
4. Contain equipment that is specifically designed and high value.

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## Part 10, Safety and health requirements for facilities and facility systems

~~g-5.~~ House communications and telemetry systems that interface with other NASA centers, International organizations, and DOD.

~~h, d.~~ Is listed in the table ~~in appendix 10, attachment 10.4A~~ at the following URL:  
[http://www6.jsc.nasa.gov/safety/FacMgr/List\\_of\\_FBD\\_Facilities.pdf](http://www6.jsc.nasa.gov/safety/FacMgr/List_of_FBD_Facilities.pdf). Organizational directors may propose addition or deletion of facilities subject to these requirements to the Safety and Test Operations Division. The list of applicable facilities is subject to change considering the scope of this chapter and risk to life, safety, mission, property, or the environment. Upon approval, the Safety and Test Operations Division may update the list in Appendix 10 without a revision to this handbook.

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### *Facility baseline documentation*

#### 3. Facility baseline documentation

If your facility meets the above criteria or is listed above, you shall develop, validate, and maintain a set of baseline documentation for your facility before beginning operations. Paragraphs 4 through 10 below describe the contents of facility baseline documentation.

#### 4. Configuration control documentation

You shall:

- a. Have a documented system to identify and control your facility's configuration that meets JPD 8820.3, "Facility Configuration Management Program."
- b. Document your configuration control system in your general operating procedures described in paragraph 5 below. ~~See JPD-8820.3 for a list of document types.~~
- c. Keep or have access to the following documentation:
  1. Current facility drawings used to construct or modify the facility. Usually these drawings are for the construction of facilities projects and don't include the facility equipment.
  2. Equipment drawings used to install or modify facility equipment such as test instrumentation, test article fixtures, and test equipment. These drawings may include functional schematics, block diagrams, or one-line drawings.
  3. Nonmetallic materials surveys that identify and approve (via a Materials Usage Control Board) all nonmetallic materials used in a test article, facility, or system in a reactive environment.

## Chapter 10.4, Facility baseline documentation requirements for critical, complex, or hazardous JSC facilities

### 5. General operating procedures

You shall have a general operating procedures document that contains your basic policies, describes your facility organization and its functions and responsibilities, and describes how you collect and control your facility baseline documentation. This may be included in test plans, operating plans, readiness reviews/inspections, work instructions, management system documents, or customer agreements, provided all elements are addressed and revised as appropriate as conditions change. A general operating procedure shall include:

- a. General operating requirements that describe how you implement your policies and fulfill your functions and responsibilities. This includes:
  1. Requirements for test plans, test procedures, and data management.
  2. The organization of test teams and review boards.
- b. Facility operating requirements that describe how you maintain configuration control, cleanliness, environmental impact control, and materials control.
- c. Organization interface agreements that define the responsibilities of organizations that use or operate your facility and how those organizations work together.
- d. Data management requirements that define how you handle, reduce, print, distribute, control, and store data from tests or operations of the facility. You shall include requirements to keep backup copies of critical documentation in a separate location.
- e. Safety requirements and procedures to make sure your facility operations are safe. You shall address these items:
  1. Safety reviews
  2. Emergency planning and fire protection planning, to include access to electronically controlled areas during emergency operations involving loss of power
  3. Certification and recertification of pressure systems and lifting equipment
  4. Equipment calibration
  5. Tests involving human subjects
  6. Operations in vacuum or oxygen-enriched environments
  7. Operations with hazardous materials
- f. A variance process that defines how you evaluate and approve variances from any requirements that you need to follow or from your own policies and procedures. You shall follow Chapter 1.4, "Written safety and health program," of this handbook to request a variance from any JSC or higher requirement.
- f.g. Methods for accessing any electronic documentation, including center-wide systems.

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## **Part 10, Safety and health requirements for facilities and facility systems**

### **6. Detailed procedures**

You shall have detailed procedures that described how you operate machinery or systems, conduct tests, and control resources and schedules. Limitations, controls, and requirements associated with paragraph 5, above, and paragraph 7, below, must be incorporated as necessary to assure that hazards and key operating conditions are fulfilled. You may develop these procedures yourself or use manufacturers' procedures when available.

### **7. Safety documentation**

You shall keep the following documents:

- a. Hazard analyses that identify hazards and hazard controls in hardware or software systems and their human interfaces. You shall have hazard analyses on the facility, facility systems, and facility equipment approved by the Safety and Test Operations Division. The hazard analysis may also include an environmental impact assessment as described in JPR 8553.1, "JSC Environmental Management System Manual."
- b. Failure mode and effects analyses that analyze the effects of a system, subsystem, or component failure on the safety of people and equipment. You only need to do failure mode and effects analyses on critical systems or as deemed necessary from your hazard analysis.
- c. Safety review records that document inspections by contractor or civil service organizations. These records shall, as a minimum, identify safety discrepancies found and the corrective actions taken. You shall process safety discrepancies open more than 30 days per Chapter 3.5, "Hazard Correction Tracking." Document and track them in the JSC HATS.
- d. Breathing air records that validate the quality of the air used by personnel.

### **8. Training documentation**

You shall have the following training documents:

- a. Training requirements that define the minimum training needed to qualify personnel to operate equipment or systems, or to be a member of a test team. Training may include formal academic training, classroom courses, on-the-job training, and certification. You shall also address recertification if necessary. This includes environmental training per JPR 8550.1, "JSC Environmental Compliance Procedural Requirements."
- b. Training records that show completion of training requirements.

### **9. Maintenance documentation**

You shall have developed and implemented a preventative maintenance plan for all critical systems and equipment. Maintenance documents describe how you maintain the facility, facility systems, and facility equipment in a safe working order and show maintenance history. You may use manufacturers' maintenance manuals. These documents include:

#### Chapter 10.4, Facility baseline documentation requirements for critical, complex, or hazardous JSC facilities

- a. Manuals that describe necessary maintenance and upkeep.
- b. Procedures and programs for routine and unscheduled maintenance, including recertification of hoists, cranes, elevators, and pressure systems.
- c. Records that document maintenance done on the facility, systems, and equipment.

### 10. Other documentation

You shall keep the following documents:

- a. Records from a readiness review, such as an operational readiness inspection or a user readiness review that approved your facility if such a review was done.
- b. Test readiness review records that document the actions, recommendations, and approval of a test readiness review board. This applies only to test facilities.
- c. Documentation that shows management approval of any variances granted.
- d. Other records that document such things as pressure system certification, lift hardware certification, and instrument calibration.

### *Other requirements*

### 11. Maintaining facility baseline documentation

You shall:

- a. Keep facility baseline documentation as centrally located as practical to keep it accessible to personnel responsible for operating, maintaining, and assessing the facility condition.
- b. Keep the documentation updated in a manner that assures accuracy immediately before and during hazardous operations.
- c. Follow JPD 1440.6, “NASA Records Management,” and NPR 1441.1, “NASA Records Retention Schedules” (current version), for keeping, archiving, or destroying records.

### 12. Responsibilities for facility baseline documentation

- a. As an *organizational director*, you are responsible for:
  - 1. Deciding which of your facilities needs to follow the requirements in this chapter.
  - 2. Making sure each facility or laboratory manager has the required facility baseline documentation.
  - 3. Reviewing the status of your facility baseline documentation during readiness reviews or inspections to make sure it meets this chapter. If your facility is used continuously or frequently, you may define prescribed intervals for review based on maintenance requirements or change milestones.

## **Part 10, Safety and health requirements for facilities and facility systems**

4. Bringing any discrepancies found during your review to the attention of the responsible facility or laboratory manager for corrective action.
  5. Providing facility baseline documentation to the Safety and Test Operations Division during its review of facility baseline documentation.
- b. The Safety and Test Operations Division is responsible for auditing facility baseline documentation in each facility annually to make sure that it meets the requirements of this chapter as follows:
1. Facility baseline documentation is subject to assessment in readiness reviews, audits, and facility inspections.
  2. Consider facility risk, age, and criticality in scheduling inspections and audits.
  3. Address nonconformance with this chapter per Chapter 3.5, “Hazard Correction Tracking.”



# Chapter 12.5

## General Asbestos Work Requirements

### 1. What this chapter covers:

This chapter covers the following general requirements for any asbestos work at JSC, to include:

- a. Medical surveillance requirements.
- b. Training requirements.
- c. Respiratory protection requirements.
- d. Personal protective clothing and equipment.
- e. Decontamination.
- f. Secure electrical, fire, and HVAC systems.
- g. Electrical power hazards.
- h. Slips, trips, and falls.
- i. Confined spaces.
- j. Ladders and scaffolds.
- k. Heat stress.
- l. Prohibited activities.

### 2. Medical surveillance requirements

You shall follow these requirements for medical surveillance:

- a. You can find medical surveillance requirements in three OSHA regulations. Refer to the listed regulations for details and specifications of these requirements. Note that all three regulations require a physician's written opinion. These three regulations are:
  1. 29 CFR 1926.1101, "Construction Industry Standard for Asbestos," requires employees who perform Class I, II, and III asbestos work for 30 or more days per year, or those who are exposed to airborne concentrations of asbestos at or above the PEL, to be enrolled in a medical surveillance program. Medical examinations are required before asbestos work or exposure (pre-placement) and annually thereafter.
  2. 29 CFR 1910.1001, "General Industry Standard for Asbestos," requires all employees who are exposed to airborne concentrations of asbestos at or above the PEL to be enrolled in a medical surveillance program. Medical examinations are required before asbestos work or exposure (pre-placement), annually, and upon termination of employment.
  3. 29 CFR 1910.134, "Respiratory Protection Standard," specifies that any employee required to wear respiratory protection equipment while performing his or her job

## Part 12, Asbestos Control Requirements

shall receive a medical evaluation. Medical examinations are required to determine an employee's ability to use a respirator before that employee is fit tested or required to use a respirator.

- b. The frequency of medical evaluations for asbestos workers and respirator wearers at JSC is also listed in Chapter 3.6 of this handbook.
- c. The medical support contractor provides medical surveillance of JSC civil service employees. On-site resident support contractor employees receive medical surveillance as specified in their contract. Fixed-price contractors shall provide the required medical surveillance from medical resources other than JSC.
- d. No ambient levels of asbestos fibers have been identified within JSC facilities that would expose building occupants to even a significant fraction of the JSC action level. Therefore, no requirement exists for building occupants to be placed on an asbestos-related medical surveillance program.

### 3. Training requirements

The following subparagraphs list the JSC minimum training requirements for Class I, II, III, and IV asbestos work. The OSHA Construction Industry Standard for Asbestos,<sup>29</sup> CFR 1926.1101(k)(9), provides the basis for this training. Complete the training for your appropriate class of asbestos work before or at the time of your initial assignment and take refresher training at least annually thereafter. Training requirements are as follows:

- a. **All Class I work:** Training equivalent to the EPA Model Accreditation Plan asbestos abatement worker training specified in 40 CFR 763, Subpart E, Appendix C. This is a 4-day training class that includes specific lecture topics and demonstrations, hands-on training, a current individual respirator fit test, a course review, and a written test. Individuals who possess a current certificate issued under 25 TAC 295.42 for an Asbestos Abatement Worker have demonstrated that they have met this requirement. Currency in this training expires exactly 12 months after the date of the initial or last refresher training, and individuals may not perform Class I work activities until they have again received refresher training in this topic. Any individual who lets more than 24 months lapse since the date of his or her last training shall retake the 4-day initial training.
- b. **Class II work that uses critical barriers or negative pressure enclosures:** Training equivalent to the EPA Model Accreditation Plan asbestos abatement worker training specified in 40 CFR 763, Subpart E, Appendix C. This is a 4-day training class that includes specific lecture topics and demonstrations, hands-on training, a current individual respirator fit test, a course review, and a written test. Individuals who possess a current certificate issued under 25 TAC 295.42 for an Asbestos Abatement Worker have demonstrated that they have met this requirement. Currency in this training expires exactly 12 months after the date of the initial or last refresher training, and individuals may not perform Class II work activities until they have again received refresher training in this topic. Any individual who lets more than 24 months lapse since the date of his or her last training shall retake the 4-day initial training.

## Chapter 12.5, General Asbestos Work Requirements

- c. **All other Class II work:** Only for work involving ACM roofing materials, flooring materials, siding materials, ceiling tiles, or transite; training shall meet these requirements:
1. Be equivalent to the requirements specified in 29 CFR 1926.1101(k)(9)(iv).
  2. Include specific topics listed in 29 CFR 1926.1101(k)(9)(viii) and work practices or procedures from 29 CFR 1926.1101(g).
  3. Take a minimum of 8 hours.
  4. Currency in this training expires exactly 12 months after the date of the initial or last refresher training; individuals may not perform Class II work activities until they have again received refresher training in this topic. Any individual who lets more than 24 months lapse since the date of his or her last training shall retake the initial training.
  5. These workers shall also have a current respirator fit test.
- d. **Class III work and Class IV emergency response work:** Training shall meet these requirements:
1. Be equivalent to the requirements specified in 29 CFR ~~190~~26.1101(k)(9)(v) and 40 CFR 793.92(a)(2). This 16-hour training class includes specific topics, work practices, respiratory protection, and hands-on training.
  2. Currency in this training expires 12 months after the date of the initial or last refresher training. Individuals who can demonstrate that they are scheduled for refresher training may continue to perform Class III and Class IV emergency response asbestos-related work on site at JSC until receiving the scheduled refresher training, but not longer than 14 months after the date of their last training.
  3. Any individual who lets more than 24 months lapse since the date of his or her last training shall retake the initial training.
  4. These workers shall also have a current respirator fit test.
  5. When emergency response involves a cleanup of a major fiber release episode, the responders shall have training meeting the requirements of Class I asbestos work (see above).
- e. **Restricted Class III asbestos operations and maintenance work:** All employees (contractor or civil service) at JSC who work in ceiling plenums or mechanical rooms, beneath computer floors, and anywhere that ACM could potentially be disturbed shall complete the 6-hour JSC “Class III Asbestos Operations and Maintenance (O&M) (Restricted)” course offered by the OHD. This course, along with medical surveillance or evaluation and a current respirator fit test, is required before conducting restricted Class III activities at JSC. Refresher training requires completion of the 2-hour JSC “Class III Asbestos Operations and Maintenance (O&M) (Restricted) (Refresher)” course offered by the OHD. Additional discussion about this JSC training is provided below:
1. The work is considered restricted because it is limited to the specific areas and specific conditions at JSC where activities have the potential to disturb asbestos-

## Part 12, Asbestos Control Requirements

containing SAI or to disturb dirt or dust containing SAI debris, but does not include removal of any ACM. This encompasses work in ceiling plenums or mechanical rooms, beneath computer floors, and anywhere that ACM could potentially be disturbed. For example, entry into ceiling plenums to “pull cables” or install electrical utility lines in buildings with SAI falls under this classification.

2. The JSC Class III Asbestos O&M (Restricted) initial and refresher courses neither address nor train workers to perform the other types of Class III asbestos-related work, such as glovebag removal or spot abatement of ACM. If you perform actual removal of ACM for operations and maintenance activities, you shall meet the appropriate training requirements for asbestos Class I, II, or III work as described in the paragraphs above.
3. The JSC Class III Asbestos O&M (Restricted) course is required for all workers performing this type of work on site at JSC, regardless of any other asbestos training that they may have received, since it acquaints them with the conditions found at JSC.
4. Currency in the JSC Class III Asbestos O&M (Restricted) training expires 12 months after the date of the initial or last refresher training. Individuals who can demonstrate that they are scheduled for refresher training at the Safety Learning Center may continue to perform restricted Class III asbestos-related operations and maintenance work on site at JSC until receiving the scheduled refresher training, but not longer than 14 months after the date of their last training. If you let more than 24 months lapse since the date of your last training, you shall retake the initial training.
- f. **Class IV work (except emergency response):** Training equivalent to the requirements specified in 29 CFR 1926.1101(k)(9)(vi) and 40 CFR 793.92(a)(2). This 2-hour awareness training class includes specific topics and work practices. If you are involved in housekeeping and custodial activities at JSC in areas with ACM (e.g., acoustical or decorative treatments and flooring materials), you shall meet this training requirement. If you are a JSC custodial worker, use HEPA vacuum cleaners and methods to avoid the generation of asbestos fibers from flooring materials as referenced in 29 CFR 1910.1001(k) and 29 CFR 1926.1101(l).
- g. **Resilient Floor Covering Institute (RFCI):** Training in the methods specified by the RFCI for the removal of resilient floor coverings and adhesives that contain asbestos. These floor coverings may be: (i) sheet flooring that contains asbestos or has an asbestos felt backing, (ii) vinyl or asphalt floor tiles, or (iii) adhesives and mastics. Individuals removing floor coverings and adhesives using RFCI methods at JSC shall also have Class II (32-hour) or Class III (16-hour) asbestos training as required by the activity. The specific RFCI methods may be found in the RFCI document “Recommended Work Practices for Removal of Resilient Floor Coverings” at <http://www.dshs.state.tx.us/asbestos/pdf/ARC022.pdf>.
- h. Training for any employees likely to be exposed above the PELs for asbestos shall meet the minimum training requirements specified in both 29 CFR 1910.1001(j)(7) and 29 CFR 1926.1101(k)(vii) and (viii).

## Chapter 12.5, General Asbestos Work Requirements

- i. Training for employees required to wear respiratory protection for any level of work involving asbestos materials shall meet the requirements of 29 CFR 1910.134.
- j. Fixed-price contractors subject to these training requirements shall provide documented proof of required training for their workers and supervisors before proceeding with work identified within Part 12.
- k. Building occupants shall receive asbestos awareness training through the annual JSC requirement for Hazard Communication Training.

### 4. Respiratory protection requirements

The following requirements apply for respiratory protection:

- a. JSC policy requires the use of respirators when they are necessary to protect the health of the employee and reduce the risk of asbestos exposure during asbestos-related activities. Locate the basic OSHA requirements in 29 CFR 1910.134; they are also referenced in this handbook. If you wear respiratory protection for any level of asbestos work, you shall have an annual individual respirator fit test.
- b. JSC provides respirators at no cost to civil service employees. Respiratory protection for on-site support contractor employees will be provided as specified in their contract. Fixed-price contractors subject to these requirements shall furnish their own equipment and provide documented proof of fit testing, medical surveillance, and training for their workers and supervisors before proceeding with work identified within Part 12.
- c. If you perform any Class I, II, or III asbestos work at JSC, you shall wear appropriate respiratory protection. If you perform Class IV asbestos work, you may be required to wear respiratory protection. Select respirators based on the requirements stated in either 29 CFR 1926.1101(h) or 29 CFR 1910.1001(g).
- d. Any employer requiring employees to wear respiratory protection shall develop a written Respiratory Protection Program plan meeting the criteria detailed in 29 CFR 1910.134.
- e. The JSC Occupational Health Officer or his or her designated representative shall approve the written Respiratory Protection Program plan.
- f. Select all respiratory protection devices from those approved by NIOSH. Workers performing asbestos activities are prohibited from wearing a filtering face-piece respirator. If you must wear a respirator, you shall not wear a beard or other facial hair that would interfere with the facial seal with the face piece. Any job superintendent, a designated competent person, or a Certified Industrial Hygienist who determines that an employee's existing facial hair prevents the effective use of a respirator shall not allow the employee to work at any job requiring a respirator until the facial hair is removed. See Chapter 5.6 of this handbook for contact lens use.
- g. Eyeglasses require special mounts inside full-face respirators. Under no conditions allow eyeglass temple pieces to penetrate the face seal of the respirator. Any breathing air for

## Part 12, Asbestos Control Requirements

supplied air respirators or self-contained breathing apparatus shall meet Grade D breathing air specification of 29 CFR 1910.134.

### 5. Personal protective clothing and equipment

You shall follow these requirements to protect yourself:

- a. Provide personal protective clothing and equipment required for employees engaged in asbestos-related activities as specified in Part 12. You can find basic information on PPE in this handbook. If workers are exposed to hazardous noise, they may also find information on hearing protection in this handbook. Additionally, you can find OSHA requirements on PPE in the following standards:
  - 29 CFR 1910.132, “General Requirements for Personal Protective Equipment”
  - 29 CFR 1910.133, “Eye and Face Protection”
  - 29 CFR 1910.135, “Head Protection”
  - 29 CFR 1910.136, “Foot Protection”
  - 29 CFR 1910.138, “Hand Protection”
  - 29 CFR 1910.95, “Occupational Noise Exposure”
- b. Wear protective clothing and equipment during asbestos-related work to protect from gross contamination of the body, hair, etc., and to provide protection from other physical hazards in the workplace. The proper use of protective clothing, coupled with the appropriate use of decontamination showers, as required, and HEPA-filtered vacuum cleaners, will minimize your chance of bringing asbestos out of the work area and into your general environment and home.
- c. Use protective equipment, such as hard hats and eye protection, in those activities in which there is risk of head injury from falling objects or eye injury from foreign objects. If you’re required to wear a half-mask respirator, you shall wear safety glasses with side shields or safety goggles.
- d. If you work in areas where there is a possible danger of head injury from impact, falling or flying objects, or electrical shock or burns, you shall wear a protective helmet as determined by the designated competent person, the job supervisor, or the JSC Safety and Test Operations Division.
- e. Protective clothing does not include street clothes (or shoes), T-shirts, blue jeans, sweatbands, kneepads, and socks. If you use any of these items inside the work area, you shall remain there until the job is completed and either be decontaminated using HEPA-filtered vacuum cleaners or wet wiping, or alternatively have these items disposed of as asbestos-contaminated waste.
- f. Keep other protective clothing or items, such as hard hats and safety shoes or boots, if required, or other appropriate footwear in the work area for the duration of the project. Upon project completion, you can clean these items, place them in a plastic bag, label

## Chapter 12.5, General Asbestos Work Requirements

them as containing asbestos, and take them to the next project. If these items cannot be decontaminated, dispose of them at the end of the project as asbestos-containing waste.

- g. Protective clothing for asbestos-related work shall consist of disposable coveralls and gloves. These coveralls are normally paper or a synthetic material (i.e., Tyvek) ~~coverall~~. They include with built-in or attached hoods and booties. Do not cut the hood or booties from the coveralls. After each use, discard these items as asbestos-contaminated waste. Disposable coveralls, such as Tyvek, are extremely vulnerable to hot surfaces or open flames. They burn rapidly, and some plastic materials may melt and severely damage exposed skin.

### 6. Decontamination

You shall follow these requirements for decontamination after asbestos work:

- a. Visible signs of asbestos will not be tolerated in areas serving building occupants. Therefore, everyone shall go through the decontamination sequence after leaving a regulated asbestos work area for any reason.
- b. The degree of decontamination necessary is directly proportional to the potential of exposing someone outside the work area. For the majority of JSC jobs, where disposable clothing is worn and where an enclosure is not required, first use a HEPA-filtered vacuum on or wet wipe the protective clothing, then carefully remove the protective clothing and bag it as asbestos-containing waste. Bag contaminated materials for disposal as asbestos waste.
- c. When it is necessary to work within a large enclosure, in-process through a “hygiene unit” or “clean room” to change from street clothes into work clothes and out-process through the decontamination or hygiene units to remove contaminated work clothing, decontaminate, and change back into street clothes.

### 7. Secure electrical, fire alarm, and HVAC systems

You shall take the following actions to secure critical systems before starting asbestos work:

- a. Secure or deactivate all electrical, fire alarm, and HVAC systems in the work area before a major abatement activity, especially when it is necessary to construct a large enclosure. Activities involving small-scale or incidental asbestos exposure will generally not require securing the electrical, fire alarm, or HVAC systems; however, you will need to evaluate this on a case-by-case basis. Regardless, you shall coordinate any outage of electrical or HVAC systems through work control using established procedures.
- b. The amended water used to saturate ACM creates a humid environment. To eliminate the potential hazard, you shall de-energize the electrical systems serving the work area and control their operation before any wet operations begin.

## Part 12, Asbestos Control Requirements

- c. Fire alarm sensors are triggered during abatement activities. You shall disable them before and throughout the project and have the Fire Protection Coordination Office approve all fire alarm sensor outages.
- d. The HVAC system, if left operational in an asbestos work area, represents a potential route and means for spreading ACM fibers into other areas of the facility and, therefore, increases the risk of employee exposure. You shall shut down, isolate, and control the HVAC in the work area before and during any asbestos-related activity.
- e. All vents and air ducts inside the work area shall be covered and sealed with two layers of 6-mil plastic and tape.
- f. If the HVAC system supplying the work area supplies other areas in the building that are still operational, de-energizing the system may not be feasible; you shall develop an alternate method of isolating the work area portion of the HVAC.
- g. Control electrical and HVAC systems shut down or de-energized at the point of isolation with an orange JSC Form 19A, "WARNING – DO NOT OPERATE" tag, and a lock (the lock shall be a color other than red). Use this tag and the operation or energy control procedures found in Chapter 8.2 of this handbook to ensure the systems are controlled.

## 8. Electrical power hazards

One of the most common hazards, and one that gives the least warning, is electrical power. Incorrect wiring, improper grounding, and lack of proper shielding in the wet environment of asbestos-related activities can significantly increase workers' risk. To lessen the risk of injury, you shall refer to the requirements in this handbook and take the following actions:

- a. De-energize as much of the work electrical system as possible.
- b. Use portable light systems.
- c. Use nonconductive scrapers, tools, and vacuum attachments.
- d. Use hot-line covers over energized cables and power lines when possible.
- e. Use caution to avoid damaging power cable insulation with scrapers, shovels, scaffolding, and wheeled equipment.
- f. Avoid stringing electrical wiring across floors. Elevate wiring, if possible, to keep it away from litter on the floor, physical abuse, and damage from equipment use.
- g. Use stable, wooden or fiberglass ladders – not metal.
- h. Consider electrical equipment and lines to be energized unless tested and determined otherwise.
- i. Extension cords used with portable electric tools and appliances shall be of the three-wire type and connected to a GFCI.



## Chapter 12.5, General Asbestos Work Requirements

- j. All 120-volt, single-phase, 15- and 20-ampere receptacle outlets in the work area that are not part of the permanent wiring of the building or structure shall be equipped with an approved GFCI.
- k. Establish and implement an assured equipment grounding conductor program covering all cord sets and receptacles that are not part of the permanent wiring of the building or structure, and equipment connected by cord and plug, which is available for use or used by employees on asbestos-related activities covered by Part 12.

### 9. Slips, trips, and falls

Asbestos-related projects, particularly abatement projects, are inherently dangerous for numerous reasons: the presence of multiple layers of plastic sheeting on the floor, the accumulation of debris, poor lighting, and the need to work from ladders and scaffolds. To deal with these problems, you shall take steps to prevent slips and falls in the work areas:

- a. Install the first layer of floor sheeting as tight and flat as possible. Secure the second layer of plastic to the first with tape, spray adhesive, or other means. (This will reduce the chance of the two layers sliding over one another.)
- b. Keep electrical lines off the work floor by taping them high on the wall, behind the wall plastic if possible.
- c. Do not allow debris from abatement activities to pile up or lay about. Pick up and place the material in appropriate containers at the time of generation.
- d. Select a secure area out of the normal traffic pattern for the temporary storage of waste bags.
- e. For plastic floor sheeting on stairs, install a nonskid surface over the plastic on each tread. Do not cover stairs unless they require protection from water damage.
- f. Ensure that all workers in the work area wear a good-quality protective shoe or boot. Rubber boots that provide good traction are preferred. Rubber boots also provide some protection from electrical shock as well as being easy to clean. Workers should not wear Tyvek booties on the outside of their work shoes.
- g. Always follow established procedures for the installation and use of ladders and scaffolds.
- h. Most abatement work requires that the worker be constantly looking at the ceiling or pipes overhead. Thus, every worker shall always be on the lookout for tools, cable equipment, etc., left lying about the work area that may trip them as they move about.

### 10. Confined spaces

Confined spaces may be encountered in asbestos-related activities. *A confined space is a space that, by design, has limited openings for entry and exit; that has unfavorable natural ventilation, which could contain asbestos fibers, other hazardous materials or is oxygen*

## Part 12, Asbestos Control Requirements

*deficient; and that is not intended for continuous employee occupancy.* Confined spaces can include, but are not limited to, storage tanks, process vessels, pits, vats, degreasers, security vaults, boilers, underground utility tunnels or vaults, and pipelines. This handbook and the OSHA requirements in 29 CFR 1910.146 govern entry into confined spaces during asbestos-related activities. Anyone working in a confined space at JSC shall complete the JSC Confined Space Training Course at the JSC Safety Learning Center or the Houston Area Safety Council before working in a confined space at JSC. Any asbestos-related work in a confined space, including the underground utility tunnels, requires a confined space procedure and permit approved by the OHD and the Safety and Fire Protection contractor. See Chapter 6.10 of this handbook for more information.

### 11. Ladders and scaffolds

Asbestos-related activities specified in Part 12 routinely use ladders and scaffolds. Both items represent potential safety hazards. Use ladders and scaffolds at JSC per the requirements of this handbook, and the OSHA requirements of 29 CFR 1910.25, 29 CFR 1910.26, 29 CFR 1926.450–454, and 29 CFR 1926.1053.

### 12. Heat stress

You shall take the following measures to control heat stress:

- a. Control employees' total heat exposure when conducting JSC asbestos-related activities so that workers are not exposed to combinations of metabolic and environmental heat, which produce unacceptable heat stress. Heat stress, for the purpose of Part 12, is the total effect of environmental and physical factors that makes up the total heat load imposed on the body. Unacceptable heat stress is defined as any combination of metabolic and environmental heat, which produces any symptom or adverse effect.
- b. Several biological effects can occur from heat stress. They include, in increasing order of severity, heat rash, heat cramp, heat exhaustion, and heatstroke. Heatstroke is an acute medical emergency that requires immediate medical attention. If you are a work area supervisor, you shall be familiar with the signs and symptoms of these conditions and take appropriate action whenever any worker shows signs of heat stress.
- c. The major factors affecting heat exchange between a person and the environment are air temperature and humidity, skin temperature, air velocity, evaporation of sweat, and radiant temperature, as well as type, amount, and characteristics of clothing. Summer weather in Houston is both hot and humid.
- d. Protective clothing required for asbestos-related activities serves as a barrier against gross contamination of the body by asbestos materials and the potential spread of asbestos to uncontrolled environments. It also alters the rate and amount of heat exchange between the skin and the ambient air, thus increasing the stress of metabolic and environmental heat.

## Chapter 12.5, General Asbestos Work Requirements

- e. The effects of heat stress can be increased if the individual is using alcohol, therapeutic drugs, or social drugs while being exposed to high heat stress in the work environment. Many drugs prescribed for therapeutic purposes also affect the body's mechanisms for adapting and adjusting to heat stress. If you require therapeutic medication, you may not work asbestos-related activities that may promote heat stress unless you are under the supervision of a physician who provides a written opinion that you will not be adversely affected by the heat stress of the proposed work activity.
- f. To the extent possible, only employees acclimated to heat stress will be used in asbestos-related activities requiring full protective clothing and work area enclosures.

### 13. Prohibited activities

While in a regulated asbestos work area, you shall NEVER:

- a. Smoke
- b. Eat
- c. Drink
- d. Chew gum or tobacco or use snuff
- e. Apply cosmetics



# Chapter 12.7

## Competent Person

### 1. Requirement

JSC requires that all asbestos-related work, which meets the definition of construction work in 29 CFR 1910.12 and 29 CFR 1926.1101(a), be conducted under the supervision of a competent person as defined below.

*A **competent person** is one who is capable of identifying existing and predictable hazards in the work area or unsanitary, hazardous, or dangerous working conditions, and who has authority to take prompt corrective measures (29 CFR 1926.32(f)).*

The following requirements apply to a competent person:

- a. 29 CFR 1926.1101(b) ~~require states that the~~ “...competent person means, in addition to the definition in 29 CFR 1926.32 (f), one who is capable of identifying existing asbestos hazards in the workplace and selecting the appropriate control strategy for asbestos exposure...” and “... who has the authority to take prompt corrective measures to eliminate them, as specified in 29 CFR 1926.32(f) ~~be capable of selecting the appropriate strategy to control asbestos exposures.~~” The competent person shall ensure that all asbestos work follows the approved work practices and work plans.
- b. The duties of the **competent person** to supervise asbestos-related work and to perform inspections and other activities are detailed in 29 CFR 1926.1101(o). According to JSC policy, if you are a **competent person**, you shall be capable of performing the class of asbestos-related work over which you have control. Per Part 12, as a competent person, sign the “Job Procedure Requirements and Notification Form” (see Chapter 12.1). If the assigned competent person is not at the job site, he or she should visit the job site periodically during the course of the work.

### 2. Qualifications

The following qualifications are required for a competent person:

- a. Class I and Class II competent person:
  1. If you are designated a competent person for any Class I and Class II asbestos work, you shall demonstrate current training meeting the requirements of EPA’s Model Accreditation Plan (40 CFR 763, Subpart E, Appendix C) for supervisor, or its equivalent. This 5-day training course includes specific lecture topics, demonstrations, at least 14 hours of hands-on training, individual respirator fit testing, a course review, and a written test. If you have a current license issued under 25 TAC 295.46 for an Asbestos Abatement Supervisor, then you have demonstrated that you have met this requirement.
  2. This training expires exactly 12 months after the date of the initial or last refresher training; you may not perform as a Class I or Class II competent person until you have

## Part 12, Asbestos Control Requirements

again received refresher training in this topic. If you have let more than 24 months lapse since the date of your last training, you shall retake the 5-day initial training.

3. Must have a minimum of 6 months experience as a Contractor/Supervisor or as an OSHA Class I/II asbestos abatement worker.
- ~~2.4.~~ Pass a written test developed and administered by OHD, to evaluate the ability of the candidate to identify and predict asbestos hazards in the work place and to demonstrate a working knowledge of OSHA, EPA, and JSC asbestos regulations, policies, and procedures.

b. Class III and Class IV competent person:

1. As a competent person for any Class III and Class IV asbestos work, you shall demonstrate current training meeting the requirements of 40 CFR 763.92(a)(2) for custodial and maintenance staff. This training consists of at least 16 hours in specific topics, demonstrations, and hands-on training in the use of respiratory protection, other personal protective measures, and good work practices. (See Chapter 5, paragraph 3.e. for more details on this training.) (**Note:** Individuals who are a Class I or Class II Asbestos Contractor, Asbestos Supervisor, or Asbestos Worker competent person-qualified have met this requirement.)
2. As a competent person for Class III and Class IV work, you shall also complete the 6-hour “Class III Asbestos Operations and Maintenance (O&M) (Restricted)” course offered by OHD. This training is required to familiarize you with JSC policies and procedures as well as the conditions to be found at JSC.
3. As a competent person for Class III and Class IV work, you shall take the 2-hour JSC “Class III Asbestos Operations and Maintenance (O&M) (Restricted) (Refresher)” course offered periodically by OHD to remain current as a Class III/IV competent person.
4. If you are a Class III and Class IV competent person but *only* oversee Class III O&M (Restricted) or Class IV activities, the 2-hour JSC “Class III Asbestos Operations and Maintenance (O&M) (Restricted) (Refresher)” course is the only refresher course you need to take.
5. If as a Class III competent person you oversee minor asbestos abatement (e.g., single glove bag removal or spot abatement with waste limited to one asbestos waste bag), you shall take *both* the JSC 2-hour JSC O&M (Restricted) refresher course *and* an annual refresher for the 16-hour 40 CFR 763.92(a)(2) training. (**Note:** Individuals who maintain currency as a Class I or Class II competent person only need to take the JSC 2-hour JSC O&M (Restricted) refresher course.)
6. The training described in this paragraph expires 12 months after the date of your initial or last refresher training. If you can demonstrate that you are scheduled for refresher training, you may continue to perform as a Class III or Class IV competent person on site at JSC until receiving the scheduled refresher training, but no longer than 14 months after the date of your prior training. If you let more than 24 months

## Chapter 12.7, Competent Person

lapse since the date of your last training, you shall retake the 16-hour initial training and the JSC 6-hour “Class III Asbestos Operations and Maintenance (O&M) (Restricted)” course.

7. Must have a minimum of 6 months experience as a Contractor/Supervisor or as an OSHA Class I/II asbestos abatement worker.

~~6-8.~~ Pass a written test developed and administered by OHD, to evaluate the ability of the candidate to identify and predict asbestos hazards in the work place and to demonstrate a working knowledge of OSHA, EPA, and JSC asbestos regulations, policies, and procedures.

- c. You shall have sufficient authority to take prompt corrective measures to ensure compliance with OSHA, EPA, TDH, and TCEQ regulatory requirements and guidelines.
- d. You shall be qualified to use respiratory protection (see requirements in Chapter 12.5).





# Chapter 12.9

## Regulated Areas, ~~and~~ Site Preparation, and Negative Pressure Enclosures

### 1. What this chapter covers

This chapter outlines the asbestos work requirements for regulated areas, ~~and~~ site preparation, and negative pressure enclosures. Organizations and contractors performing these tasks for asbestos work shall follow industry accepted practices and procedures, and comply with applicable OSHA and EPA regulations.

### 2. Regulated areas

You shall conduct all Class I, Class II, Class III, and Class IV emergency response asbestos-related work at JSC within a regulated area. The methods and systems for establishing a regulated area are described in paragraph 3 below.

The OSHA definition (29 CFR 1926.1101) of a regulated area is:

*An area established to demarcate areas where asbestos work is conducted, and any adjoining area where debris and waste from such asbestos work accumulate; and a work area within which airborne concentrations of asbestos exceed, or there is a reasonable possibility they may exceed, the permissible exposure limit.*

You shall follow these requirements:

- a. *Demarcation.* Mark the regulated area in any manner that minimizes the number of persons within the area and protects persons outside the area from exposure to airborne asbestos. Where critical barriers or negative pressure enclosures are used, demarcate the regulated area with the barriers or enclosures. Provide signs and display as required by Chapter 12.10 of this handbook.
- b. *Access.* Limit access to regulated areas to people who are authorized and trained to perform asbestos work and who are wearing protective clothing and equipment. Establish a list of authorized personnel before starting a job and post that list in the unrestricted clean area of the job site. The job site superintendent or on-site competent person has control of site access.
- c. *Respirators.* Supply all persons entering a regulated area where employees are required to wear respirators with a respirator that meets OSHA standards 29 CFR 1926.1101(h) and 29 CFR 1910.134.
- d. *Prohibited activities.* People inside a regulated area shall never eat, drink, smoke, chew tobacco or gum, or apply cosmetics.

## Part 12, Asbestos Control Requirements

### 3. Methods and systems used to establish a regulated area

You shall follow these requirements to establish a regulated area:

- a. Every regulated area used for asbestos-related activities specified in Part 12 shall use at least one of the methods or systems described below to prevent visible emissions from the worksite and to prevent the escape of airborne asbestos fibers into the general environment. Any method used shall meet the engineering control requirements of 29 CFR 1926.1101(g). Submit a work plan for any task requiring a large-scale enclosure to the APM per the notification requirements of Part 12.
- b. The methods and systems for Part 12 and the job performance requirements are classified into the following four systems:
  1. Barrier with floor covering
  2. Glovebag
  3. Small enclosure or mini-enclosure
  4. Large enclosure
- c. You may use barriers with no enclosure if there is little risk of spreading asbestos into the general area or if there is minimal risk to individuals who may pass into the work area unknowingly. Barriers are used when the primary concern is to keep building occupants or other employees from inadvertently getting into the work area where there might be a localized risk of asbestos exposure. The barriers may be any marker (i.e., signs, tapes, barricades) that visually identifies the area and warns employees or visitors to stay out of the work area. These systems are used with polyethylene floor coverings to prevent localized contamination.
- d. Use glovebags when the work is small enough to be completed in the bag. These are usually restricted for use on pipes, joints, and valves, but may be used for spot abatement of small amounts of spray-applied asbestos insulation. *NEVER PERFORM GLOVEBAG REMOVAL ON HOT PIPES!* This may cause the bag or gloves to melt over the workers' hands and arms. Devise special procedures if glovebags are used on hot pipes.
- e. Use small enclosures when the work area is larger than can be accommodated by a glovebag or is needed to provide more protection than a barrier system. The small enclosure is generally limited in size and used for small-scale, short-duration activities. A small enclosure may not involve the use of negative pressure systems, but will have an entrance chamber or multiple entry flaps. Small enclosures rely on HEPA-filtered vacuums and wet methods to control fiber concentrations. You may use small enclosures for any repair or maintenance activity that may disturb ACM and release airborne asbestos fibers.
- f. Use large enclosures for asbestos-related projects that a small enclosure cannot accommodate. Large enclosures will usually include the use of a negative-pressure air filtration system to isolate the work area from the general building area that is not involved in the asbestos-related activity. The large enclosure may involve the use of ancillary contamination controls (e.g., showers, change or clean rooms, waste load out

## Chapter 12.9, Regulated Areas and Site Preparation, and Negative Pressure Enclosures

chambers, decontamination rooms, contaminated equipment rooms, etc.). Large enclosures for Class I and Class II asbestos work shall pass inspection by the OHD before the asbestos-related activities start.

- g. The OSHA regulations in 29 CFR 1926.1101 use the term “critical barrier.” A critical barrier consists of “one or more layers of plastic sealed over all openings into a work area or any other similarly placed physical barrier sufficient to prevent airborne asbestos in a work area from migrating to an adjacent area.” Critical barriers are most often used on doorways, windows, and ventilation system openings. They are required for Class I and II asbestos work, but may also be used on Class III work.
- h. Table 12.9-1 below indicates the regulated area methods and systems that are appropriate for each class of asbestos work. Please note that containment for an emergency response could involve any of the four methods and depends upon the judgment of the responders. Essentially, an emergency response to a major fiber release episode could involve procedures meeting the requirement of Class I or Class II asbestos abatement or removal.

Table 12.9-1. Regulated Area Methods or Systems Used with Asbestos Work Classes

Methods or Systems	Asbestos Class			
	I	II	III	IV*
Barrier and floor covering			X	X
Glovebag			X	X
Small enclosure	X	X	X	X
Large enclosure	X	X	X	X
Critical barriers	X	X		X

\*Only required for asbestos Class IV emergency response.

### 4. Site preparation

Before any asbestos-related activity, prepare the worksite for follow-on actions. You shall take the following steps to define the regulated area and limit contamination of furniture and equipment.

- a. *Post warning signs and barriers.* Place warning signs and temporary barriers, if an enclosure is not required, at all entrances and approaches to the regulated area. Warning signs shall meet the requirements specified in Chapter 12.10.
- b. *Cleaning and removal of furnishings and equipment.* Remove all non-stationary items that can feasibly be taken from the work area to prevent damage or contamination of the items.

## Part 12, Asbestos Control Requirements

1. Before storing these items outside the work area, clean them of visible debris with a HEPA-filtered vacuum or wet wipe to remove any asbestos-containing dust.
  2. Thoroughly pre-clean the designated work area before beginning containment construction. If carpets in the work area remain, vacuum them with a HEPA-filtered vacuum and cover them with 6-mil polyethylene sheeting. You may use plywood between the layers of polyethylene to help protect the carpets from damage and maintain the containment integrity.
- c. *Follow these requirements for sealing stationary items:*
1. If it is not feasible to remove items from the work area, completely cover them with a minimum of one layer of 6-mil polyethylene. For Class I and Class II activities, seal these covers and secure them with duct tape.
  2. If stationary equipment such as electrical transformers, refrigeration equipment, or other electrical heat-generating equipment shall continue to operate during the asbestos-related activity, make special provisions to prevent creating a fire hazard. Such items shall have constant ambient airflow or they may overheat. In these situations, provide a separate framework to support the polyethylene sheeting, with provision for separate air intake and exhaust outside the defined work area.

### 4. Negative Pressure Enclosures

You shall follow these requirements for any negative pressure enclosure (NPE) used with OSHA Class I and Class II asbestos abatements projects:

- a. The machine used to maintain a NPE must provide at least 4 air changes per hour and maintain a pressure differential of at least -0.02 column inches of water inside the NPE relative to outside pressure. (Ref OSHA 29 CFR 1926.1101(g)(5)(i)(A))
- b. The NPE must be kept under negative pressure throughout its period of use. (Ref OSHA 29 CFR 1926.1101(g)(5)(i)(A))
- c. Pressure measurements shall be recorded for the NPE throughout its entire period of use. The recording of the pressures may be done by either using a strip-chart recorder on the manometer or by an employee writing down the pressure readings on a log sheet at hourly intervals.
- d. An employer maintaining a NPE must have an employee immediately available for the entire period of use to take action to restore negative pressure in case the machine maintaining the NPE fails.
- e. The machine maintaining the NPE shall run continuously until passing a clearance inspection and, as applicable, passing clearance air sampling.

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# Chapter 12.15

## Job-Specific Performance Requirements - General Information

### 1. General job-specific performance requirements

You shall follow these requirements for asbestos jobs:

- a. Attachments 12A-12G, in Appendix 12B, contain individual Job-Specific Performance Requirements (JPRs) for the most common jobs at JSC that potentially involve ACM. Table 12.15-1 below lists the activities by Class of asbestos work as defined in Chapter 12.4 of this Handbook. All JPR numbers reflect the Class of asbestos work being performed. Table 12.15-1 also lists the attachment from Appendix 12B that describes the performance requirements. Each description in the appendices provides sufficient information to determine which jobs fit within the procedure.
- b. Following the job description in each attachment is a listing of minimum requirements for completing the described asbestos work. These listings may not be complete and trained asbestos workers are expected to perform all Classes of asbestos-related work using industry accepted work practices and controls. Work supervisors and competent persons shall exercise discretion on some requirements; e.g., determining the size of containment system or enclosure for Class I asbestos work.
- c. Table 12.15-1 also lists the minimum training requirements needed to perform each JPR. The training abbreviations shown in the table, and their meanings from Chapter 12.5, paragraph 3, are:
  1. 32-hour worker: training specified in 40 CFR 763, Subpart E, Appendix C, for all Class I work and Class II work, to include the use of critical barriers and negative pressure enclosures.
  2. 16-hr O&M: training specified in 29 CFR 1926.1101(k)(9)(v) and 40 CFR 763(a)(2) for Class III operations and maintenance work, involving Class III glovebag or spot abatement activities.
  3. JSC 6-hr: training for Restricted Class III Asbestos Operations and Maintenance Work as shown in Chapter 12.5, paragraph 3. This training does not allow workers to perform removal of any amount of ACM.
  4. 2-hr: Class IV awareness training required by 29 CFR 1926.1101(k)(9)(vi) and 40 CFR 763(a)(2) for housekeeping and custodial activities.
  5. RFCI: Training in the methods specified by the Resilient Floor Covering Institute (RFCI) for the removal of resilient floor coverings and adhesives which contain asbestos. The specific methods used may be found in the RFCI document “*Recommended Work Practices for Removal of Resilient Floor Coverings*” at <http://www.dshs.state.tx.us/asbestos/pdf/ARC022.pdf>.

## Part 12, Asbestos Control Requirements

- d. If you do not find the asbestos-related work in one of the listed procedures in Table 12.15-1 or Attachments 12A-12G, in Appendix 12B, define the job by the Class of asbestos work as found in Chapter 12.4 of this Handbook or in 29 CFR 1926.1101, and then develop an alternative procedure as required by Chapter 12.2 of this Handbook.
- e. Plan all asbestos-related work following the procedures in Chapter 12.1 and 12.2 of Part 12 of this Handbook.

### 2. Exposure control program

The underlying assumptions behind the development of the exposure controls reflected in the JPRs are:

- a. All tasks involving potential asbestos exposure require some degree of control. Hence, the removal of even one ceiling tile in a building known to contain asbestos SAI is covered by Part 12. The degree of control is tailored to the potential of exposure to workers and to building occupants.
- b. When it is necessary to open an area of suspended ceiling in a building containing SAI, such that a total of 32 square feet or more (i.e., the 4th contiguous ceiling tile) is exposed, you shall erect a small enclosure.

~~e. Spot removals of less than one (1) contiguous square foot of SAI do not require the erection of a small enclosure, provided that safeguards such as wetting and catching the material close to the scrape and protection of underlying areas are taken and the total waste generated does not exceed the capacity of a standard asbestos waste bag.~~

~~d.c.~~ Spot removals ~~between 1 and 3 contiguous square feet of any amount~~ of SAI require the erection of an ~~small~~ enclosure, but ~~do not~~ require specific decontamination facilities such as showers. Place the enclosure under local negative pressure using a HEPA-filtered vacuum cleaner or negative-pressure systems as described within Part 12. Klean Kubes®, or equivalent units, are commercially available for this purpose. You shall use additional safeguards such as wetting and catching the material close to the scrape.

~~e.d.~~ Any job that requires the removal of 3 contiguous square feet or greater of asbestos from a surface (other than a pipe surface if glovebag procedures are used), or which has a sufficient number of small-scale spot removals such that the cumulative amount of insulation removed exceeds 35 cubic feet, 160 square feet, or 260 linear feet of pipe is, under this program, a major asbestos removal operation. Major removals require the submission of a work plan to the APM, which details how the enclosure, decontamination, monitoring, record keeping, and clearance requirements are to be satisfied.

~~f.e.~~ The above assumptions represent JSC's best effort in interpreting the OSHA and EPA guidelines, which are based on specific fiber concentrations, and establishing a workable program for controlling asbestos exposure. The OHD will monitor various jobs to determine whether the degree of control described above provides adequate environmental and health protection. Therefore, the performance requirements may be

## Chapter 12.15, Job-Specific Performance Requirements - General Information

revised. For example, it may be necessary to reduce the small enclosure criteria to below 32 square feet, if controls are inadequate.

### 3. Waivers to job performance requirements

Except for JPR III-13 (see Attachment 12F), no waivers to the JPR procedures in Appendix 12B, Attachments 12A-12G will be issued. The following requirements apply.

- a. In buildings with SAI, raised computer floors and sub-floors may contain SAI debris from activities performed in the building before asbestos work was regulated at JSC. The entry into any computer floor or sub-floor, in a building containing SAI, is normally considered Class III asbestos work governed by JPR III-13. The JSC Occupational Health Officer, or his designee, may issue a waiver releasing workers from these Class III requirements under the following conditions:
  1. The area can be easily delineated above and below the raised flooring into “clean” and “dirty” sections. Normally, the delineation shall be done by rooms defined by hard walls above the floor. The Occupational Health Officer, or his designee, may establish other delineation in special cases.
  2. Clean the area below the raised floor (as well as any equipment or cabling below the floor), the flooring support structure, and the flooring tiles using wet wiping and mopping methods and HEPA vacuuming. Clean any items removed from the sub-floor area by wet wiping or HEPA vacuuming as they are removed from the floor. Clean following the procedures shown in JPR III-13. Workers performing these activities shall wear protective clothing and respiratory protection.
  3. The JSC Occupational Health Officer, or his designee, will visually inspect the sub-floor area after cleaning. The basic standard of cleanliness for the sub-floor area is no visible dust or debris.
  4. When the JSC Occupational Health Officer, or his designee, is satisfied about the cleanliness of the sub-floor area, he or she will issue a JPR III-13 Waiver for the specific area cleaned. Post the waivers on the JSC Health Home page at <http://ks.jsc.nasa.gov/hh/scripts/AsbestosLink.htm> and file them with the OHD. The waivers, once issued, do not expire.
  5. Personnel entering an area with a JPR III-13 Waiver are encouraged to use a HEPA vacuum for periodic housekeeping under the sub-floor.
- b. Even though a waiver to JPR III-13 procedures may be issued, there may be other installed suspect ACM beneath the sub-floor. These materials may include, but are not limited to, cementitious pipe chase materials, transite board, sub-floor stanchion mastic, firewalls, floor tiles and mastic, etc. If any sub-floor activities are planned, which may disturb these materials, you shall determine the asbestos content, or presumed asbestos content, and follow other appropriate JPR requirements.

Part 12, Asbestos Control Requirements

<i>Table 12.15-1</i>				
<i>Job Performance Requirements Listing</i>				
Asbestos Work Class	Task Title	JPR No.	Reference App. 12B Atch No.	Min. Req'd Training
<u>Class I</u>				
	Large scale removal of structural or ceiling insulation (SAI or acoustical) (>3 sq ft contiguous <del>at a single spot</del> <del>and</del> >160 sq ft cumulative <del>for the task</del> )	I-1	12A	32-hr worker
	Small scale <del>or spot</del> removal of structural or ceiling insulation (SAI or acoustical) ( <del>4 to</del> ≥ 3 sq ft contiguous <del>at a single spot</del> and <160 sq ft cumulative <del>for the task</del> )	I-2	12A	32-hr worker
	Spot removal of structural or ceiling insulation (SAI or acoustical) (<3 <del>sq ft</del> contiguous <del>at a single spot</del> and <160 sq ft cumulative <del>for the task, or waste exceeds capacity of one standard waste bag</del> )	I-3	12A	32-hr worker
	Large scale removal of piping and vessel insulation (Piping: >3 ft continuous or > 260 ft cumulative) (Vessel: >3 sq ft contiguous or >160 sq ft cumulative or >35 cu ft cumulative) (Glovebag not technically feasible)	I-4	12A	32-hr worker
	Small scale removal of piping and vessel insulation (Piping: <3 ft continuous and < 260 ft cumulative) (Vessel: <3 sq ft contiguous and <160 sq ft cumulative or <35 cu ft cumulative) (Glovebag not technically feasible)	I-5	12A	32-hr worker
	Small scale removal of piping insulation using more than one glovebag; limited to 25 feet of insulation from one continuous pipe run or to 25 feet of cumulative insulation from a piping system at one location.	I-6	12A	32-hour worker
<u>Class II</u>				
	Removal of or modification to wallboard, plaster, transite, ceiling tiles, flooring, roofing, or siding containing asbestos (Friable material; airborne concentrations ≥0.01 f/cc)	II-1	12B	32-hr worker
	Removal of or modification to wallboard, plaster, transite, ceiling tiles, flooring, roofing, or siding containing asbestos (Airborne concentrations <0.01 f/cc)	II-2	12B	32-hr worker



**Chapter 12.15, Job-Specific Performance Requirements - General Information**

**Table 12.15-1 (continued)**

<b>Asbestos Work Class</b>	<b><u>Task Title</u></b>	<b>JPR No.</b>	<b>Reference App. 12B Atch No.</b>	<b>Min. Req'd Training</b>
<u>Class II (cont'd)</u>	Removal of resilient sheet flooring using procedures and methods specified by the Resilient Floor Covering Institute (RFCI) to include: (i) any quantity of ACM sheeting, (ii) any quantity of sheeting with ACM backing or mastic.	II-3	12B	32-hr worker plus RFCI
	Removal of flooring using procedures and methods specified by the Resilient Floor Covering Institute (RFCI) to include: (i) any ACM vinyl or asphalt tile or (ii) any vinyl or carpet tile with ACM mastic; where area exceeds 40 sq ft or where waste will exceed the capacity of one standard waste bag.	II-4	12B	32-hr worker plus RFCI
<u>Class III</u>				
Class III Glovebag	Repair steam, chilled water, hot waterlines, and valves with asbestos-containing material	III-1	12C	16-hr O&M
Class III Barrier & Floor	Modification to structural steel members in close proximity to SAI (barrier and floor covering <32 sq ft)	III-2	12D	16-hr O&M
Covering	Removal of wall partitions <del>or plaster ceilings</del> in close proximity to ACM (barrier and floor covering <32 sq ft)	III-3	12D	16-hr O&M
	Removing or replacing of ACM or non-ACM ceiling tile(s) below ceiling plenum in buildings with spray-applied asbestos insulation or fireproofing (SAI) (waste limited to one standard waste bag) (ceiling opening <32 sq ft)	III-4	12D	JSC 6-hr
	Removing ACM ceiling tiles in Buildings without SAI (waste limited to one standard waste bag)(ceiling opening of <32 sq ft)	III-5	12D	JSC 6-hr
	Any activity in plenum above suspended ceiling tiles in buildings with spray-applied asbestos insulation or fireproofing (SAI) (ceiling opening <32 sq ft)	III-6	12D	JSC 6-hr
	<del>Spot removal of SAI (&lt;1 sq ft contiguous and &lt;160 sq cumulative) (waste limited to one standard waste bag)</del>	<del>III-7</del>	<del>12D</del>	<del>16-hr O&amp;M</del>
	Spot removal of ACM containing wallboard, tape, or mud (waste limited to one standard waste bag)	III-18	12D	16-hr O&M

Part 12, Asbestos Control Requirements

Table 12.15-1 (Continued)

Asbestos Work Class	Task Title	JPR No.	Reference App. 12B Atch No.	Min. Req'd Training
<u>Class III Enclosure</u>	<u>Spot removal of SAI (&lt;3 sq ft contiguous at a single spot and &lt;160 sq cumulative for the task)</u>	<u>III-7</u>	<u>12E</u>	<u>16-hr O&amp;M</u>
<u>Class III Enclosure</u>	Modification to structural steel members in close proximity to SAI (control zone $\geq$ 32 sq ft)	III-8	12E	16-hr O&M
	Removal of wall partitions <del>or plaster ceilings</del> in close proximity to ACM (control zone $\geq$ 32 sq ft)	III-9	12E	16-hr O&M
	Removing or replacing of non-ACM ceiling tile(s) below ceiling plenum in buildings with spray-applied asbestos insulation or fireproofing (SAI) (waste limited to one standard waste bag) (ceiling opening $\geq$ 32 sq ft)	III-10	12E	JSC 6-hr
	Removing ACM ceiling tiles (Waste limited to one standard waste bag) (Ceiling opening $\geq$ 32 sq ft)	III-11	12E	JSC 6-hr
	Any activity in plenum above suspended ceiling tiles in buildings with spray-applied asbestos insulation or fireproofing (SAI) (Ceiling opening $\geq$ 32 sq ft)	III-12	12E	JSC 6-hr
	<u>Removal of plaster or sheetrock ceilings below ceiling plenum in buildings with spray-applied asbestos insulation or fireproofing (SAI)</u>	<u>III-19</u>	<u>12E</u>	<u>16-hr O&amp;M</u>
Class III Other	Any activity below raised computer floor and sub-floor in buildings with spray applied fireproofing or ACM acoustical ceilings	III-13	12F	JSC 6-hr
	Replace ACM valve gasket	III-14	12F	16-hr O&M
	Maintenance of equipment used in asbestos work	III-15	12F	16-hr O&M
	Repair of equipment with ACM insulation	III-16	12F	16-hr O&M
	Removal of 40 sq ft or less of (i) ACM vinyl or asphalt floor tile (ii) non-ACM floor tile with ACM mastic; or (iii) carpet tiles with ACM mastic, using procedures and methods specified by the Resilient Floor Covering Institute (RFCI) (waste limited to one standard waste bag)	III-17	12F	16-hr O&M plus RFCI
<u>Class IV</u>				
	Changing air filters in HVAC system air handling units	IV-1	12G	2-hr
	Custodial work in areas with exposed, friable ACM	IV-2	12G	2-hr
	Custodial work involving ACM flooring	IV-3	12G	2-hr
	Emergency response action to incidental fiber release	IV-4	12G	32-hr worker

## Chapter 12.15, Job-Specific Performance Requirements - General Information

## Attachment 12A

### Class I Asbestos Work

**Class I Asbestos Work:** Removal of structural or ceiling insulation (SAI or acoustical) or removal of other surfacing material and of piping and vessel insulation.

**JPR I-1:** Structural, large-scale: Removal of ceiling insulation (SAI or acoustical) or other surfacing material of greater than or equal to 3 ft<sup>2</sup> of contiguous area, ~~or and~~ cumulative total of spot removals is greater than or equal to 160 ft<sup>2</sup> of materials that have been identified as containing greater than 1% asbestos. The materials being removed constitute a significant source of ACM, and abatement could reasonably be expected to contaminate adjoining areas.

**JPR I-2:** Structural, small-scale: Spot removal of ceiling insulation (SAI or acoustical) or other surfacing material ~~with between 1 and~~ greater than or equal to 3 ft<sup>2</sup> of contiguous area at a single spot ~~with and the~~ cumulative total of spot removals ~~is of~~ less than 160 ft<sup>2</sup> of materials that have been identified as containing greater than 1% asbestos. The materials being removed constitute a potentially significant source of ACM, and abatement could reasonably be expected to contaminate adjoining areas.

**JPR I-3:** Structural, spot: Spot removal of ceiling insulation (SAI or acoustical) or other surfacing material of less than ~~43~~ ft<sup>2</sup> in contiguous area ~~with and the~~ cumulative total of spot removals ~~of less~~ greater than 160 ft<sup>2</sup> of materials that have been identified as containing greater than 1% asbestos. The materials being removed constitute a potential source of ACM, and abatement could reasonably be expected to contaminate adjoining areas if proper work practices are not followed. ~~Waste generated exceeds the capacity of a standard asbestos disposal bag.~~

**JPR I-4:** Piping/vessel, large-scale: Removal of piping insulation greater than 3 linear feet (lf) or a cumulative total of spot removals of pipe insulation greater than or equal to 260 lf; or removal of vessel (e.g.; boiler) insulation greater than 3 ft<sup>2</sup>, or a cumulative total of vessel spot removals of greater than or equal to 160 ft<sup>2</sup> or greater than 35 ft<sup>2</sup>. These removals involve materials that have been identified as containing greater than 1% asbestos. The materials being removed constitute a significant source of ACM, and abatement could reasonably be expected to contaminate adjoining areas. Because of the size or geometry of the equipment involved, a glovebag is not a technically feasible method for removal.

**JPR I-5:** Piping/vessel, small-scale: Removal of piping insulation of less than 3 lf, or a cumulative total of spot removals of pipe insulation of less than 260 lf, or removal of insulation from vessels of less than 3 ft<sup>2</sup>, or a cumulative total of vessel spot removals of less than 160 ft<sup>2</sup> or less than 35 ft<sup>2</sup>. These removals involve materials that have been identified as containing greater than 1% asbestos. The materials being removed constitute a significant source of ACM, and abatement could reasonably be expected to contaminate adjoining areas. Because of the size or geometry of the equipment involved, a glovebag is not a technically feasible method for removal.

To accomplish these Class I asbestos work activities, a number of sequential and concurrent steps are required. The most prominent of these are listed below. You will find specific details for performing all required activities by referring to accepted industry practices and procedures

## Attachment 12A

### Class I Asbestos Work (cont.)

based on requirements found in 29 CFR 1926.1101, 29 CFR 1910.1001, and 40 CFR 763, as amended.

1. A competent person must verify training, medical, and PPE requirements are complete and current.
2. Notify and coordinate task with proper officials (facility manager, work area supervisor, OHD, Environmental Office as needed).
3. Notify OHD at least 2 weeks before job start to coordinate inspections and air sampling.
4. Notify JSC Environmental Office at least 15 working days before job start if project exceeds EPA (Clean Air Act/NESHAP) criteria (260 lf, 160 ft<sup>2</sup>, or 35 ft<sup>3</sup>) for removal of ACM for them to make required regulatory notifications to the TDSHS.
5. Ensure supervision by a properly qualified, competent person.
6. Establish regulated area, post warning signs, and rope off area with barricade tape.
7. Shut down and isolate the HVAC system. Control operation/energy with a JSC Form 19A, "WARNING – DO NOT OPERATE" tag.
8. Secure and isolate the electrical system and control its operation/energy with a JSC Form 19A, "WARNING – DO NOT OPERATE" tag. Disable the fire alarm systems as necessary and obtain approval for outages from the Fire Protection Coordination Office.
9. Clean and remove furniture and fixtures.
- 10. Pre-clean work area.**
11. Seal stationary items with polyethylene.
12. Install containment system, critical barriers, coverings, and airlocks (airlocks are mandatory for large enclosures; a double entrance curtain ("Z" flap) is mandatory for small enclosures).
13. Secure work area.
14. Install change room, shower, and waste load-out facilities (large-scale enclosure).
15. Install negative-pressure air system (large-scale enclosure).
16. Install negative-pressure air or HEPA-vacuum system for negative pressure (small-scale enclosure).
17. Arrange for OHD to pre-inspect the enclosure.
18. Don protective equipment and clothing and respiratory protection.
19. Maintain HEPA vacuum system in standby mode (spot-removal surfacing).
20. Wet ACM.
21. Remove ACM
22. Conduct personnel and area sampling concurrently with removal of ACM.

## Attachment 12A

### Class I Asbestos Work (cont.)

23. Bag removed ACM.
24. Prepare bagged ACM for disposal.
25. Conduct cleaning and inspection following procedures in Chapter 12.
26. Arrange for OHD to perform initial inspection.
27. Re-clean, as necessary.
28. Conduct final cleanup following procedures in Chapter 12.
29. Apply encapsulant/"lockdown" to abatement and contiguous areas.
30. Arrange for OHD to conduct clearance visual inspection and clearance air sampling.
31. Decontaminate personnel and equipment by HEPA vacuum. Remove disposable protective clothing and bag as asbestos waste. Shower and exit through change room as appropriate.
32. Disassemble enclosure/decontaminated system after approval from OHD.
33. Call Work Control Center to dispose of all ACM and asbestos-contaminated waste. Record Work Control number on Asbestos Work Permit.
34. Disestablish regulated area.
35. OHD to provide written notification to facility manager that area can be returned to routine activities.
36. Abatement contractor to write report/provide records to Environmental Office/Asbestos Program Manager, as required.

**JPR I-6:** Small scale removal of piping insulation using more than one glovebag; limited to 25 ft of insulation from one continuous pipe run or to 25 ft of cumulative insulation from a piping system at one location. Never slide glovebags along piping.

Repair steam, chilled water, hot water lines, and valves with asbestos-containing insulation (multiple glovebag removal). This job consists of conducting repairs and maintenance to pipes, lines, and valves. To gain access to the defective part of the pipe, line, or valve, it may be necessary to remove asbestos insulation from the item. The normal high asbestos content of these materials makes it reasonable to expect airborne concentrations of asbestos in potentially significant levels when these materials are disturbed. The amount of waste will exceed one standard glove bag; the length of insulation removed from piping, valves, and connections will not exceed 25 feet. Each section of insulation to be removed is small enough to fit in a glovebag, and there is sufficient room for tools and necessary manipulation.

If the total asbestos removal exceeds 25 lb, the work must be done following procedures under Class I Asbestos Work, JPR I-4 or I-5.

Accomplishing this job requires a number of sequential and concurrent steps. The most prominent of these are listed below. Find specific details for performing all required activities by

**Attachment 12A**

**Class I Asbestos Work (cont.)**

referring to accepted industry practices and procedures based on requirements found in 29 CFR 1926.1101, 29 CFR 1910.1001, and 40 CFR 763, as amended.

1. A competent person to verify that training, medical, and PPE requirements are complete and current.
2. Notify and coordinate job task with proper officials (facility manager, work area supervisor, and OHD).
3. Establish regulated area, post warning signs, and rope off area with barricade tape.
4. Shut down and isolate HVAC system, if possible without undue interruption of normal work activities, or install critical barriers on HVAC diffusers/vents/openings.
5. Secure electrical systems, if possible without undue disruption to work activities if in close proximity to work area. If necessary, disable fire alarm system by coordinating with the Fire Protection Coordination Office.
6. Pre-clean the work area.
7. Seal stationary items with polyethylene.
8. Cover surface areas under abatement area with 6-mil polyethylene.
9. Don protective equipment and clothing and respiratory protection.
10. Perform glovebag operations.
  - a. Install glovebag.
  - b. Establish containment negative-pressure air flow with HEPA vacuum.
  - c. Remove ACM.
  - d. Scrub and wipe down exposed piping/valves.
  - e. Use encapsulant or “lockdown” on abatement and contiguous areas.
  - f. Remove glovebag.
  - g. Repeat a–f, above, to a maximum removal/abatement of 25 lf.
11. Clean area.
12. Perform inspection and conduct final cleanup following procedures in Chapter 12.12.
13. Decontaminate and remove protective equipment.
14. Call Work Control Center to dispose of all ACM and ACM-contaminated materials. Record Work Control number on Asbestos Work Permit.
15. Disestablish regulated area.
16. Notify facility manager of job completion.

## Attachment 12B

### Class II Asbestos Work

**Class II Asbestos Work:** Removal of, or modification to, wallboard, asbestos concrete materials (e.g.: pipe, siding, roofing, transite board, plaster, ceiling tiles, wall tiles, floor tiles and sheeting, and roofing and siding shingles containing asbestos.

Tasks under Class II consist of removing wallboard, asbestos concrete materials (e.g.: pipe, siding, roofing, transite board)~~transite board, asbestos concrete, plaster,~~ ceiling tiles, wall tiles, floor tiles and sheeting, roofing, and siding shingles (i.e., ACM other than TSI and surfacing materials), regardless of quantity, where these materials have been identified as containing greater than 1% asbestos. Although these materials contain in excess of 1% asbestos, they are typically classified as non-friable. The removal of these materials is separated into two categories based on exposure plus two specific tasks for the removal of resilient flooring using RFCI methods.

**JPR II-1:** The first category is where work activities will destroy the integrity of the ACM and cause the release of asbestos fibers. ~~The airborne concentrations are likely to equal or exceed 0.01 f/cc.~~ The materials being removed constitute a significant source of ACM, and abatement could reasonably be expected to contaminate adjoining facilities and create airborne concentrations if proper controls are not followed. These removal projects will require the use of small or large enclosures.

**JPR II-2:** The second category is where work activities will not compromise or damage the integrity of the ACM. ~~Any airborne concentrations are expected to be less than 0.01 f/cc.~~ The materials being removed do not constitute potentially significant airborne fibers if ~~properly~~ removed intact and controlled. An enclosure may be necessary, but is not always required.

To accomplish these two categories of tasks, a number of sequential and concurrent steps are required. The most prominent of these are listed below. Find specific details for performing all required activities by referring to accepted industry practices and procedures based on requirements found in 29 CFR 1926.1101, 29 CFR 1910.1001, and 40 CFR 763, as amended.

1. A competent person must verify training, medical, and PPE requirements are complete and current.
2. Notify and coordinate task with proper officials (facility manager, work area supervisor, OHD, Environmental Office as needed).
3. For routine and scheduled O&M work, notify OHD at least 2 weeks before job start to coordinate inspections and air sampling.
4. Notify JSC Environmental Office (JE) at least 15 working days before the job if the project exceeds EPA (Clean Air Act/NESHAP) criteria (260 lf, 160 ft<sup>2</sup>, or 35 ft<sup>3</sup>) for removal of ACM for them to make required regulatory notifications to the TDSHS.
5. Ensure supervision by a properly qualified, competent person.
6. Establish regulated area, post warning signs, and rope off area with barricade tape.
7. Shut down and isolate the HVAC system. Control operation/energy with a JSC Form 19A, "WARNING - DO NOT OPERATE" tag.



**Attachment 12B**

**Class II Asbestos Work (cont.)**

8. Secure and isolate the electrical system and control its operation/energy with a JSC Form 19A, "WARNING - DO NOT OPERATE" tag. Disable the fire alarm systems as necessary and obtain approval for outages from the Fire Protection Coordination Office.
9. Clean and remove furniture and fixtures.
10. ***Pre-clean work area.***
11. Seal stationary items with polyethylene.
12. Install containment system, critical barriers, coverings, and airlocks (airlocks are mandatory for large enclosures; a double entrance curtain ("Z" flap) is mandatory for small enclosures).
13. Secure work area.
14. Install change room, shower, and waste load-out facilities (as necessary).
15. Install negative-pressure air or HEPA-vacuum system for negative pressure (as necessary).
16. Arrange for the OHD to pre-inspect the enclosure.
17. Don protective equipment and clothing and respiratory protection.
18. Wet ACM.
19. Remove ACM.
20. Conduct personnel and area sampling concurrently with removal of ACM.
21. Bag removed ACM.
22. Prepare bagged ACM for disposal.
23. Conduct cleaning and inspection following procedures in Chapter 12.12.
24. Arrange for OHD to conduct initial visual inspection.
25. Re-clean, as necessary.
26. Conduct final cleanup following procedures in Chapter 12.12.
27. Apply encapsulant/"lockdown" to abatement and contiguous areas.
28. Arrange for OHD to conduct clearance visual inspection and clearance air sampling.
29. Decontaminate personnel and equipment by HEPA vacuum. Remove disposable protective clothing and bag as asbestos waste. Shower and exit through change room as appropriate.
30. Disassemble enclosure/decontamination system after approval from OHD.
31. Call Work Control Center to dispose of all ACM and asbestos-contaminated waste.
32. Disestablish regulated area. Record Work Control number on Asbestos Work Permit.

**Attachment 12B**

**Class II Asbestos Work (cont.)**

33. OHD to provide written notification to facility manager that area can be returned to routine activities.
34. Abatement contractor to write report/provide records to Environmental Office, as required.

**JPR II-3:** Removal of resilient sheet flooring using methods and procedures specified by the RFCI to include: (i) any quantity of ACM sheeting or (ii) any quantity of sheeting with ACM backing felt or adhesive. Sheeting must be cut with a box-cutter or linoleum-knife into narrow strips and rolled up without breaking using wet methods. Since the removal of the resilient sheet flooring will most likely involve an entire room or rooms, critical barriers and entry curtains are mandatory, as is polyethylene sheeting on the lower half of the walls. If the RFCI procedures are not strictly followed, removal must be conducted under JPR II-1.

**JPR II-4:** Removal of resilient flooring using methods and procedures specified by the RFCI to include: (i) any ACM vinyl or asphalt tile or (ii) any vinyl or carpet tile with ACM mastic; where the area exceeds 40 ft<sup>2</sup> or where waste will exceed the capacity of one standard glove bag. Critical barriers and entry curtains are mandatory, as is polyethylene sheeting on the lower half of the walls. Tiles must be removed **intact**. Removal procedures must not use spud bars or Mechanical chippers. If these conditions are not or cannot be met, removal must be conducted under JPR II-1.

The RFCI document “Recommended Work Practices for Removal of Resilient Floor Coverings” may be found at: <http://www.dshs.state.tx.us/asbestos/pdf/ARC022.pdf>. RFCI procedures prohibit sanding, sawing, drilling, grinding, abrasive blasting, bead blasting, dry sweeping, dry scraping, and mechanical chipping or pulverizing of resilient flooring, lining, backing felt, and adhesive materials.

To accomplish these two specific tasks, a number of sequential and concurrent steps are required. The most prominent of these are listed below. Workers will wear protective clothing and respiratory protection. Find specific details for performing all required activities by referring to the accepted RFCI industry practices and procedures.

1. A competent person must verify training, medical, and PPE requirements are complete and current.
2. Notify and coordinate task with proper officials (facility manager, work area supervisor, OHD, Environmental Office as needed).
3. For routine and scheduled O&M work, notify OHD at least 2 weeks before job start to coordinate inspections and air sampling.
4. Notify JSC Environmental Office (JE) at least 15 working days before the job if the project exceeds EPA (Clean Air Act/NESHAP) criteria (260 lf, 160 ft<sup>2</sup>, or 35 ft<sup>3</sup>) for removal of ACM for them to make required regulatory notifications to the TDSHS.
5. Ensure supervision by a properly qualified competent person.

**Attachment 12B**

**Class II Asbestos Work (cont.)**

6. Establish regulated area, post warning signs, and rope off area with barricade tape.
7. Clean and remove furniture and fixtures.
8. ***Pre-clean work area.***
9. Seal stationary items with polyethylene.
10. Install containment system, critical barriers, coverings, and airlocks (airlocks are mandatory for large enclosures; a double entrance curtain (“Z” flap) is mandatory for small enclosures).
11. Secure work area.
12. Install negative-pressure air or HEPA vacuum system for negative pressure (as necessary).
13. Arrange for the OHD to pre-inspect the regulated area.
14. Prepare amended water/detergent solution using RFCI directions.
15. Don protective equipment and clothing and respiratory protection.
16. Remove resilient sheet flooring using RFCI methods:
  - a. If sheeting is fully-adhered, cut into strips that are 4 to 8 in. wide. Use these narrow strips for the bonded areas/edges of peripherally adhered sheeting.
  - b. If sheeting has not adhered or is peripherally adhered, cut areas that are not bonded into strips that are 18 in. wide.
  - c. While one worker rolls up the strip, a second worker keeps the sheeting, and especially the backing felt, wet with water/detergent solution.
  - d. For fully adhered sheeting, the backing felt will separate from the wear layer. If separation does not occur easily, use wet-scraping to achieve separation.
  - e. After removing a 12- to 18-in. width of sheeting, thoroughly saturate any residual backing felt and remove by wet-scraping. Rewet backing felt if water/detergent solution has not completely penetrated.
  - f. Place rolled-up flooring and wet backing felt into ACM waste bags.
  - g. After the 12- to 18-in. width is free of backing felt, HEPA-vacuum the cleaned area.
  - h. Repeat a–g, above, until sheeting and backing felt have been removed from the entire floor.
17. Remove floor tiles using RFCI methods:
  - a. Wet floor tile with water/detergent solution.
  - b. Using one of the RFCI methods, carefully remove floor tiles one at a time, keeping them intact. The RCFI methods are:
    - Wet floor tile with water/detergent solution; work a short- or long-handled scraper beneath a floor tile to exert pressure in a twisting action.

**Attachment 12B**

**Class II Asbestos Work (cont.)**

- Thoroughly heat tile with a hot air gun or radiant heat source to soften tile and adhesive, then remove by hand or with scraper.
  - Place removed tiles into ACM waste bags with water/detergent solution.
18. Remove carpet tiles that have been adhered to floor with ACM mastic. Pry or peel up carpet tiles, keep mastic wet with water/detergent solution. Place contaminated carpet tiles into ACM waste bags with water/detergent solution.
  19. Remove residual ACM mastic using RFCI wet-scraping methods and/or adhesive solvents and place into ACM waste bags. RFCI methods allow the use of adhesive solvents with a slow-speed (i.e., less than 300 rpm) floor machine and a 3M black floor pad. If using an adhesive solvent, exhaust ventilation will be required.
  20. Conduct personnel and area sampling concurrently with removal of ACM.
  21. Prepare bagged ACM for disposal.
  22. Conduct cleaning and inspection following procedures in Chapter 12.12.
  23. Arrange for OHD to conduct initial visual inspection.
  24. Re-clean, as necessary.
  25. Conduct final cleanup following procedures in Chapter 12.12.
  26. Arrange for OHD to conduct clearance visual inspection and clearance air sampling, as required.
  27. Decontaminate personnel and equipment by HEPA vacuum. Remove disposable protective clothing and bag as asbestos waste.
  28. Disassemble enclosure/decontamination system after approval from OHD.
  29. Call Work Control Center to dispose of all ACM and asbestos-contaminated waste.
  30. Disestablish regulated area. Record Work Control number on Asbestos Work Permit.
  31. OHD to provide written notification to facility manager that area can be returned to routine activities.
  32. Abatement contractor to write report/provide records to Environmental Office, as required.

Attachment 12D

**Class III – Asbestos Work – Regulated Area Defined By Barricade with Floor Covering**

***Class III - Asbestos Work – Regulated Area Defined by: A Barricade With Floor Covering:***

This set of Class III Asbestos work requires a regulated area defined by barrier or tape and warning signs. The regulated area does not require an enclosure but does require appropriate covering of horizontal surfaces with polyethylene sheeting.

If at any time during the tasks described below, ACM is noted as delaminating or creating airborne fibers, stop the project and immediately upgrade it to Class I or Class II asbestos work.

**JPR III-2:** Modifying building steel/concrete structure/decking that is in close proximity to SAI/fireproofing.

- a. This job consists of modifying building components (e.g.: steel or concrete structural members; steel or concrete decking) which is in close proximity to SAI for which drilling, hammering, or similar activities could be reasonably expected to disturb the ACM.
- b. For the purposes of this task, it is assumed that the area requiring the incorporation of control techniques is less than (<) 32 square feet around the spot of penetration or disturbance. When it is necessary to drill through or hammer steel in proximity to ACM that could be disturbed by the construction or maintenance activity, take precautions to minimize the quantity of asbestos released. Precautions would include evacuation of nonessential personnel within the area of the activity, and wetting of ACM before work to prevent fiber release.
- c. In those instances where modifications are made to structural members covered with SAI, then Class I asbestos work, JPRs I-1, I-2, or I-3 will apply.

**JPR III-3:** Removing wall partitions ~~and/or plaster ceilings~~ in close proximity to areas with ACM.

- a. This job consists of removing and/or replacing wall partitions ~~or plaster ceilings~~ in close proximity to asbestos materials and could be reasonably expected to disturb the ACM. Airborne asbestos concentrations are expected to be minimal if proper control procedures are followed. The size of the job dictates the degree of control.
- b. For the purposes of this task, it is assumed that the area is accessible and the area requiring the incorporation of control techniques is less than (<) 32 square feet near the removal.
- c. If it is necessary to spot remove ACM in order to enhance accessibility, the controls identified in JPR I-3 will apply.

**JPR III-4:** Removing/replacing ACM or non-ACM ceiling tile(s) below areas with SAI.

- a. This job consists of removing and/or replacing suspended ceiling tiles below areas with SAI. It only applies to those tiles that can reasonably be expected to be removed without causing significant dust generation. Once the tiles are removed, other work activities can be performed in the plenum areas. Airborne asbestos concentrations are expected to be

**Attachment 12D**

**Class III – Asbestos Work – Regulated Area Defined By Barricade with Floor Covering (cont.)**

minimal, if proper control procedures are followed. However, the potential exists to disturb the SAI or to disturb asbestos-laden dust on the top of the ceiling tiles.

- b. This task is limited to less than ( $<$ ) 32 square feet of contiguous square footage opening in the ceiling and the amount of asbestos waste is limited to one standard waste bag. If the area affected is greater than or equal to ( $\geq$ ) 32 contiguous square feet, then an enclosure is required (see JPR III-10)

**JPR III-5: Removing ACM ceiling tiles in buildings without SAI.**

- a. This job consists of removing suspended ceiling tiles known to contain greater than 1% asbestos and the removal occurs below areas which do not have asbestos-containing SAI. This task only applies to those tiles that can reasonably be expected to be removed without causing significant generation of asbestos debris or causing the tiles to become friable.
- b. The task is further limited to less than ( $<$ ) 32 square feet of contiguous square footage opening in the ceiling and the amount of asbestos waste cannot exceed the capacity of one standard asbestos waste bag.
- c. If the affected area is greater than or equal to ( $\geq$ ) 32 contiguous square feet, then an enclosure is mandatory (see JPR III-11)
- d. If waste generated exceeds the capacity of standard disposal bags, then JPR II-2 must be used.

**JPR III-6: Work activities above suspended ceilings in the plenum space in buildings with SAI.**

- a. This job consists of work activities required to be performed in plenums; e.g., system inspections, system repairs, system installations, and pulling cables across the top of ceiling tiles or in a cable tray. Partial to whole body entry into the plenum is required. This task does not include the cutting or removal of ACM to mount cables or spot removals of ACM to penetrate floors or walls. Concentrations are reasonably expected to be low if proper precautions and procedures are incorporated into job planning.
- b. This task is limited to less than ( $<$ ) 32 square feet of contiguous square footage opening in the ceiling. If the area affected is greater than or equal to ( $\geq$ ) 32 contiguous square feet, then at least a small enclosure is required (see JPR III-12).

~~**JPR III-7: Spot removing ceiling insulation (SAI or acoustical) of less than 1 square foot in contiguous area, the waste generated does not exceed the capacity of a standard asbestos waste bag, and cumulative total of spot removals is less than 160 square feet. The materials being removed have been identified as containing greater than 1% asbestos, constitute a potential source of ACM, and abatement could reasonably be expected to contaminate adjoining areas if proper work practices are not followed. Wet methods are mandatory and the ACM must be captured close to the removal activity and transferred to a waste bag. If waste exceeds to capacity of a standard asbestos waste bag, then Class I Asbestos work, JPR I-3 must be used.**~~

**Attachment 12D**

**Class III – Asbestos Work – Regulated Area Defined By Barricade with Floor Covering (cont.)**

**JPR III-18:** Spot removal of ACM containing wallboard, joint tape, or mud; the waste generated does not exceed the capacity of a standard asbestos waste bag. The materials being removed have been identified as containing (or are presumed to contain) greater than 1% asbestos, constitute a potential source of ACM, and abatement could reasonably be expected to contaminate adjoining areas if proper work practices are not followed. Wet methods are mandatory and the ACM must be captured close to the removal activity and transferred to a waste bag. If waste exceeds the capacity of a standard asbestos waste bag, then Class II Asbestos work, JPR II-1 or II-2 must be used.

Accomplishing these jobs requires a number of sequential and concurrent steps. The most prominent of these are listed below. Find specific details for performing all required activities by referring to accepted industry practices and procedures based on requirements found in 29 CFR 1926.1101, 29 CFR 1910.1001, and 40 CFR 763, as amended.

1. Competent person to verify that training, medical and PPE requirements are complete and current.
2. Notify and coordinate job tasks with proper officials (facility manager, work area supervisor, and OHD).
3. Place barricades and signs around work area. Barricades must be placed a sufficient distance beyond the work zone to capture all debris from work activities and to ensure that no asbestos concentration exceeds applicable limits.
4. Move employees in the immediate work area out of the regulated area.
5. Shut down HVAC system if possible without unduly interrupting facility work force. The HVAC system must be shut down when disturbance of ACM or ACM containing debris could reasonably be expected to migrate to other areas.
6. Don protective equipment and clothing and respiratory protection.
7. Conduct personnel and area sampling as required.
8. Place one layer of 6-mil polyethylene beneath work area. The polyethylene must extend beyond the work zone a sufficient distance to catch/trap any asbestos debris that may fall. The polyethylene must not extend beyond the boundary of the regulated area.
9. When removing ceiling tiles:
  - a. Place ladder below first ceiling tile.
  - b. As tile is lifted, HEPA vacuum the tile grid supports.
  - c. Remove one ceiling tile. Lower carefully, maintaining horizontal orientation.
  - d. HEPA vacuum and wet wipe surface facing plenum and exposed side(s).
  - e. Wet wipe and HEPA vacuum tile hanger assembly.

JPR 1700.1

12B-15

Rev. J. ~~Change 2 (August April-201108)~~

**Verify this is the correct version before you use it by checking the on-line version.**

**Attachment 12D**

**Class III – Asbestos Work – Regulated Area Defined By Barricade with Floor Covering (cont.)**

- f. HEPA vacuum next tile to be removed, remove next tile, and wet wipe and HEPA vacuum tile hanger assembly.
  - g. Repeat for a maximum of three tiles (less than 32 square feet).
  - h. If unable to decontaminate tile, or if tiles are ACM, place in asbestos waste disposal bag.
10. If performing spot removals/abatement of SAI, or acoustical decoration, or wallboard, tape, and mud:
- a. Spray spot and surrounding area with amended water and let it soak into the ACM.
  - b. Cut with sharp knife or other tool so as not to generate asbestos fibers. Use a HEPA vacuum adjacent to the cutting tool to capture asbestos fibers/dust.
  - c. Catch asbestos waste in container held close to removal spot/area.
  - d. Clean substrate, as applicable.
  - e. Spray/mist substrate and exposed side(s) of ACM with approved encapsulant.
11. If applicable, modify structural components so as not to disturb surrounding ACM.
12. If applicable, carefully remove wall partitions or plaster ceiling materials so as to not disturb surrounding ACM. Remove material and dispose of as normal waste or as directed.
13. As applicable, perform work in plenum above suspended ceilings.
14. Wet wipe all cables, wires, conduit, and piping as they are removed from plenum area. HEPA vacuum all other items as they are removed from plenum area.
15. HEPA vacuum work area.
16. Visually inspect above ceiling and/or around work area, to ensure that there is no remaining visible ACM dust/debris.
17. Replace ceiling tiles, as applicable
18. Visually inspect and clean the regulated area and all equipment to ensure there is no visible ACM dust/debris. Follow cleaning and inspection procedures of Chapter 12.12.
19. Decontaminate personnel and all equipment by HEPA vacuum.
20. HEPA vacuum and wet wipe polyethylene placed beneath work area. If unable to decontaminate, carefully gather plastic and dispose as asbestos-contaminated waste. Follow cleaning and inspection procedures of Chapter 12.
21. Conduct final visual clearance inspection. Reclean as necessary.
22. Decontaminate disposable coveralls, remove, and dispose of as asbestos-contaminated waste.
23. Remove respirator.
24. Call Work Control Center to dispose of all ACM and ACM-contaminated materials. Record Work Control Number on Asbestos Work Permit. Notify area supervisor that task is complete.



**Attachment 12D**

**Class III – Asbestos Work – Regulated Area Defined By Barricade with Floor  
Covering (cont.)**

25. Remove barricades and signs and disestablish regulated area.
26. Notify Facility Manager of job completion.

Attachment 12E

**Class III – Asbestos Work – Regulated Area Defined by an Enclosure**

***Class III - Asbestos Work – Regulated Area Defined by an Enclosure:***

If at any time during the tasks described below, ACM is noted as delaminating or creating airborne fibers, stop the project and immediately upgrade it to Class I or Class II asbestos work.

**JPR III-7:** Spot removing ceiling insulation (SAI or acoustical) of less than 3 square foot in contiguous area, the waste generated does not exceed the capacity of one standard asbestos waste bag per individual spot, and cumulative total of spot removals is less than 160 square feet. The materials being removed have been identified as containing greater than 1% asbestos, constitute a potential source of ACM, and abatement could reasonably be expected to contaminate adjoining areas if proper work practices are not followed. Wet methods are mandatory and the ACM must be captured close to the removal activity and transferred to a waste bag.

**JPR III-8:** Modifying building steel/concrete structure/decking that is in close proximity to SAI/fireproofing.

- a. This job consists of modifying building components (e.g.; steel or concrete structural members; steel or concrete decking) that is in close proximity to SAI for which drilling, hammering, or similar activities could be reasonably expected to disturb the ACM. When it is necessary to drill through or hammer steel that is in proximity to ACM that could be disturbed by the construction or maintenance activity, take precautions to minimize the quantity of asbestos released. Precautions would include evacuating nonessential personnel within the area of the activity, and wetting ACM before work to prevent fiber release.
- b. For the purposes of this task, it is assumed that the area requiring the incorporation of control techniques requires greater than or equal to ( $\geq$ ) 32 contiguous square feet. In those instances where modifications are made to structural members covered with SAI, then Class I asbestos work, JPRs I-1, I-2, or I-3 will apply.

**JPR III-9:** Removing wall partitions ~~and/or plaster ceilings~~ in close proximity to areas with ACM.

- a. This job consists of removing and/or replacing wall partitions ~~or plaster ceilings~~ in close proximity to asbestos materials and could be reasonably expected to disturb the ACM. Airborne asbestos concentrations are expected to be minimal if proper control procedures are followed. The size of the job dictates the degree of control.
- b. For the purposes of this task, it is assumed that the area requiring the incorporation of control techniques requires greater than or equal to ( $\geq$ ) 32 contiguous square feet. If it is necessary to spot remove in order to enhance accessibility, the controls identified in JPR I-3 will apply.

**JPR III-10:** Removing/replacing ACM or non-ACM ceiling tile(s) below areas with SAI.

- a. This job consists of removing and/or replacing suspended ceiling tiles below areas with SAI. It only applies to those tiles that can reasonably be expected to be removed without

**Attachment 12E**

**Class III – Asbestos Work – Regulated Area Defined By An Enclosure (cont.)**

causing significant dust generation. Once the tiles are removed, other work activities can be performed in the plenum areas. Airborne asbestos concentrations are expected to be minimal, if proper control procedures are followed. However, the potential exists to disturb the SAI or to disturb asbestos laden dust on the top of the ceiling tiles.

- b. For the purposes of this task, it is assumed that the area requiring the incorporation of control techniques is greater than or equal to ( $\geq$ ) 32 contiguous square feet. If waste generated exceeds the capacity of a standard disposal bag, then JPR II-2 must be used.

**JPR III-11: Removing ACM ceiling tiles in building without SAI.**

- a. This job consists of the removal of ceiling tiles known to contain greater than 1% asbestos. This task only applies to those tiles that can reasonably be expected to be removed without causing significant generation of asbestos debris or causing the tiles to become friable. The amount of asbestos waste cannot exceed the capacity of one standard asbestos waste bag.
- b. For the purposes of this task, it is assumed that the area requiring the incorporation of control techniques is greater than or equal to ( $\geq$ ) 32 contiguous square feet. If waste generated exceeds the capacity of a standard disposal bag, then JPR II-2 must be used.

**JPR III-12: Work activities above suspended ceilings in the plenum space in buildings with SAI.**

- a. This job consists of work activities required to be performed in plenums; e.g., system inspections, system repairs, system installations, and pulling cables across the top of ceiling tiles or in a cable tray. Partial to whole-body entry into the plenum is required. Concentrations are reasonably expected to be low if proper precautions and procedures are incorporated into job planning. This task does not include cutting or removing ACM to mount cables or spot removals of ACM to penetrate floors, decks, or walls.
- b. For the purposes of this task, it is assumed that the area requiring the incorporation of control techniques is greater than or equal to ( $\geq$ ) 32 contiguous square feet.

Accomplishing these jobs requires a number of sequential and concurrent steps. The most prominent of these are listed below. Find specific details for performing all required activities by referring to accepted industry practices and procedures based on requirements found in 29 CFR 1926.1101, 29 CFR 1910.1001, and 40 CFR 763, as amended.

1. Competent person must verify that training, medical and PPE requirements are complete and current.
2. Notify and coordinate job tasks with proper officials (Facility Manager, Work Area Supervisor, and OHD).
3. Place barricades and signs around work area.
4. Move employees in the immediate work area out of the regulated area.

**Attachment 12E**

**Class III – Asbestos Work – Regulated Area Defined By An Enclosure (cont.)**

5. Shut down HVAC system if possible without unduly interrupting facility work force. The HVAC system must be shut down when disturbance of ACM or ACM containing debris could reasonably be expected to migrate to other areas.
6. Don protective equipment and clothing and respiratory protection.
7. Conduct personnel and area sampling as required.
8. Construct enclosure with polyethylene, incorporate an air-lock or double entrance curtain ("Z" flap).
9. Pre-clean area as necessary.
10. As necessary, use HEPA vacuum to create a negative pressure inside enclosure.
11. If removing ceiling tiles:
  - a. Place ladder below first ceiling tile.
  - b. As tile is lifted, HEPA vacuum the tile grid supports.
  - c. Remove one ceiling tile. Lower carefully, maintaining horizontal orientation.
  - d. HEPA vacuum and wet wipe surface facing plenum and exposed side(s).
  - e. Wet wipe and HEPA vacuum tile hanger assembly.
  - f. HEPA vacuum next tile to be removed, remove next tile, and wet wipe and HEPA vacuum tile hanger assemble
  - g. Wet wipe and HEPA vacuum tile hanger assembly.
  - h. Repeat as necessary for all tiles to be removed.
  - i. If unable to decontaminate tile, or if tiles are ACM, place in asbestos waste disposal bag.
12. If applicable, modify structural components so as not to disturb surrounding ACM.
13. If applicable, carefully remove wall partitions ~~or plaster ceiling materials~~ so as to not disturb surrounding ACM. Remove material and dispose of as normal waste or as directed.
14. As applicable, perform work in plenum above suspended ceilings.
15. Wet wipe all cables, wires, conduit, and piping as they are removed from plenum area. HEPA vacuum all other items as they are removed from plenum area.
16. HEPA vacuum work area.
17. Visually inspect above ceiling, around work area, to ensure that there is no remaining visible ACM dust/debris.
18. Replace ceiling tiles.
19. Perform first visual inspection of the regulated area and all equipment below ceiling to ensure there is no visible ACM dust/debris.
20. Decontaminate personnel and all equipment by HEPA vacuum.

Attachment 12E

**Class III – Asbestos Work – Regulated Area Defined By An Enclosure (cont.)**

21. Clean, inspect, decontaminate enclosure following Chapter 12.12 procedures.
22. Conduct visual clearance inspection. Reclean as necessary.
23. Disassemble enclosure, perform final visual inspection of area, clean as necessary.
24. Decontaminate disposable coveralls, remove, and dispose of as asbestos-contaminated waste.
25. Remove respirator.
26. Call Work Control Center to dispose of all ACM and ACM-contaminated materials. Record Work Control Number on Asbestos Work Permit.
27. Remove signs and disestablish regulated area.
28. Notify Facility Manager of job completion.

**JPR III-19: Removal of plaster and sheetrock ceilings below the ceiling plenum in buildings with SAI.**

This job consists of work activities to remove plaster and sheetrock ceilings below the ceiling plenums in buildings with asbestos containing spray applied insulation (SAI). The plaster is most often used with a wire-mesh support. The wire mesh or sheetrock supports may be suspended by wires from the overhead deck. The top side of the plaster or the sheetrock is assumed to be contaminated with asbestos debris. Removal of the plaster or sheetrock will create significant amounts of dust and debris which could contain some asbestos debris. Partial to whole-body entry into the plenum is required for some or all of the plaster/sheetrock ceiling removal. Asbestos concentrations are reasonably expected to be low if proper precautions and procedures are incorporated into job planning. This task does not include the abatement of any ACM SAI, but has the potential to disturb the ACM SAI if precautions are not taken.

Accomplishing these jobs requires a number of sequential and concurrent steps. The most prominent of these are listed below. Find specific details for performing all required activities by referring to accepted industry practices and procedures based on requirements found in 29 CFR 1926.1101, 29 CFR 1910.1001, and 40 CFR 763, as amended.

1. Competent person must verify that training, medical and PPE requirements are complete and current.
2. Notify and coordinate job tasks with proper officials (Facility Manager, Work Area Supervisor, and OHD).
3. Place barricades and signs around work area.
4. Move employees in the immediate work area out of the regulated area.
5. Shut down HVAC system if possible without unduly interrupting facility work force. The HVAC system must be shut down when disturbance of plaster/sheetrock dust and ACM containing debris could reasonably be expected to migrate to other areas.

Attachment 12E

**Class III – Asbestos Work – Regulated Area Defined By An Enclosure (cont.)**

6. Remove furniture and fixtures. Pre-clean area as necessary. Seal stationary items with polyethylene if they cannot be removed.
7. Construct enclosure with polyethylene sheeting.
  - a. Seal edges of enclosure and cover HVAC system vents to prevent escape of dust and debris.
  - b. Install an air-lock vestibule.
  - c. Install a waste load-out area if needed.
  - d. If ceiling is being removed from an entire room, cover the walls with a single layer of at least 6-mil polyethylene.
  - e. Cover the floor of the enclosure with two layers of at least 6-mil polyethylene.
8. Install negative-pressure air machine (large enclosure) or HEPA vacuum (small enclosure) to create a negative pressure of at least -0.02 inches H2O inside enclosure.
9. Arrange for OHD to inspect enclosure before work begins.
10. Don protective equipment and clothing and respiratory protection before entering the enclosure.
11. Conduct personnel and area sampling as required.
12. Remove ceiling:
  - a. Gain entry to ceiling through hatch, if one exists.
  - b. Otherwise, select a location to cut an opening and place ladder/work stand below. Wet the cut-line then cut opening through ceiling. Use a vacuum, HEPA (with a design used for wet application to mitigate shock hazard) to catch/collect dust generated during the cutting process. Carefully lower the cut out piece of ceiling, maintaining horizontal orientation. HEPA vacuum the surface facing plenum.
  - c. HEPA vacuum the top of the next ceiling area to be removed and then cut it out.
    - Minimize generation of plaster/sheetrock dust and debris.
    - Wet top and bottom surfaces to be cut.
    - Catch or collect dust generated by the cutting process with a HEPA vacuum.
    - Avoid, as much as possible, partial cutting and/or tearing down the ceiling since this creates more plaster/sheetrock dust and debris.
  - d. Repeat as necessary for all of ceiling area being removed.
  - e. Control plaster/sheetrock dust inside enclosure with water mist.
13. Double bag and dispose of all plaster and sheetrock waste as asbestos waste. Wet all debris as it is being bagged. Place a JSC Form 1161, "Disposal Inventory for Miscellaneous Hazardous Waste," on each waste bag. See waste disposal procedures/process in Chapter 12.14.

Attachment 12E

**Class III – Asbestos Work – Regulated Area Defined By An Enclosure (cont.)**

14. If applicable, modify structural components so as not to disturb surrounding ACM.
15. Wet wipe all cables, wires, conduit, and piping as they are removed from plenum area.  
HEPA vacuum all other items as they are removed from plenum area. .
16. Clean, inspect, decontaminate enclosure following Chapter 12.12 procedures.
17. Conduct visual inspection of the enclosure and all equipment below the ceiling plane.  
Reclean as necessary.
18. Arrange for OHD to conduct a visual clearance inspection.
19. Install new ceiling and perform other construction work.
  - a. As long as the ceiling remains open to the ACM SAI then all work will be conducted using Class III Asbestos Work procedures as described in JPRs III-8 through III-12.
  - b. Removal/Abatement of any ACM SAI will be conducted using JPRs I-1, I-2, I-3, or III-7 as appropriate.
20. After new ceiling is completely installed, conduct visual inspection and clean/reclean as necessary.
21. Arrange for OHD to perform a final visual clearance visual inspection and clearance air sampling.
22. Disassemble the enclosure and perform final visual inspection of area, clean as necessary.
23. Decontaminate equipment by HEPA vacuuming and wet wiping.
24. Decontaminate personnel and disposable coveralls, remove, and dispose of as asbestos-contaminated waste.
25. Remove respirator.
26. Call Work Control Center to dispose of all ACM and ACM-contaminated materials. Record Work Control Number on Asbestos Work Permit and on the JSC Forms 1161.
27. Remove signs and disestablish regulated area.
28. Notify Facility Manager of job completion.





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## Glossary of terms and definitions

## Glossary of terms and definitions

The following definitions are revised for Change 2:

**Mishap** - any unplanned occurrence, event, or anomaly that meets one of the definitions below; injury to a member of the public while on JSC facilities is also defined as a NASA mishap:

- **Type A mishap** - a mishap causing death or damage to equipment or property equal to or greater than \$42M; mishaps resulting in damage to aircraft or space hardware, i.e., flight and ground support hardware, meeting this criterion are included; this definition also applies to a test failure if the damage was unexpected or unanticipated or if the failure is likely to have significant program impact or visibility
- **Type B mishap** - a mishap resulting in permanent disability to one or more persons, or hospitalization, for other than observation of three or more persons, or damage to equipment or property equal to or greater than \$250,000 but less than \$42M mishaps resulting in damage to aircraft or space hardware that meets this criterion are included, as are test failures where the damage was unexpected or unanticipated
- **Type C mishap** - a mishap resulting in damage to equipment or property equal to or greater than \$250,000 but less than \$250,000, or causing occupational injury or illness that results in a lost workday case; mishaps resulting in damage to aircraft or space hardware and test failures that meet these criteria are also included
- **Mission failure** - any mishap or event of such a serious nature that it prevents accomplishment of a majority of the primary mission objectives; a mishap of whatever intrinsic severity that, in the judgment of the Program Associate Administrator—in coordination with the Associate Administrator for Safety, Reliability, Maintainability, and Quality Assurance, NASA Headquarters—prevents the achievement of primary mission objectives as described in the Mission Operations Report
- **Incident** - a mishap consisting of less than Type C severity of injury to personnel, but more than first-aid severity, or property damage equal to or greater than \$1,000 but less than \$250,000; events that have small property loss, less than \$1,000, should be reported as incidents if they have significantly greater potential or high visibility

**Test Equipment** – portable hardware that is unique to a specific test or training exercise, does not require integration into the test facility (i.e. plug-in versus hard-wired), and is removed immediately after the test.

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**Variance-Waiver** - documented and approved permission to perform some act contrary to established requirements